

## ITEC - WP 4

### D4.1 - Teacher skills and competence development for classrooms of the future

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<sup>1</sup> PU = Public

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## DOCUMENT HISTORY

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## Executive summary

This deliverable of Workpackage 4 (deliverable 4.1) focuses closely on the requirements of iTEC Project to identify the technical and pedagogical skills that teachers need to effectively act in the classroom of the future. A structured framework for teachers' competences is organised according to three levels of complexity and around five key dimensions: Digital Knowledge, Planning and Management, Classroom practices, Professional development and Social & Ethical Domain. This framework is aligned with (i) today's key technological and educational trends and with (ii) the skills that are expected to be evidenced by learners in the near future, which are frequently referred to as 21st-century skills.

Also analysed in this document are the pedagogical models that can be used to describe and define students and teachers role in the classrooms of the future. Based on a learner-oriented perspective, non-traditional pedagogical models, with emphasis on the notion of learning in communities of practice, project based learning and game base learning, are presented. They are seen as appropriate examples of methodological and didactical tools that can be used by teachers for implementing engaging and innovative classroom activities.

Moreover, the document investigates effective models of teachers' professional development and reviews international research studies and inspiring examples of European countries programs around ICT-teacher training, which are considered as applicable for framing iTEC initiatives on teachers' continuous professional development and education.

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# **I. INTRODUCTION**

## **i. Reminder of the context**

The WP4 focuses on a large-scale validation of iTEC Project learning scenarios that have been developed into learning and/or assessment activities by WP3. WP4 also provides mechanisms to support teachers and national coordinators in implementing scenarios; this includes training on iTEC tools and technical support provided by WP6, as well as high quality professional development and a community of practice for teachers. WP4 aims to (i) identify scenarios for the future classroom that have potential to be taken to scale after the end of the project and impact on the educational reform process at national and European level; (ii) equip teachers and national coordinators involved with pedagogical and technological knowledge and skills needed to implement scenarios and to provide enduring mechanisms to support teachers outside the project in developing and running future classrooms and (iii) design, carry out and report a large-scale pilot involving up to 1,000 classrooms and at least 12 Ministries of Education looking at the design of the future classroom in terms of both technology and teaching methods. For the large-scale pilots, WP4, working with other project partners, aims to select scenarios for the future classroom that engage teachers and pupils but that can also be tested with a critical mass of schools in each of the five project cycles. The large-scale piloting will focus on pupils in the first 2-3 years of secondary school with a particular focus on Maths, Science and Technology, as well as on primary education.

## **ii. Purpose and scope of the task**

The purpose of this deliverable is to identify the technical and pedagogical competences that are seen as required for teachers to effectively teach in the classroom of the future and, at the same time, conceptually explore new pedagogical models that could support more engaging learning experiences for students.

Task 4.1 also presents the intention of investigating effective models of professional development, as well as collecting and reviewing inspiring examples of relevant models for teacher education that can be integrated into iTEC practices mainly in Tasks 4.4 and 4.5, both focusing on providing pedagogical support and improving teacher in-service training.

### **iii. Relationship with other tasks**

This document relates very closely with Tasks 4.4 and 4.5 in the extent that it focuses on providing pedagogical support and improving teacher education.

It is also strictly related to WP 6 tasks, which focus on the training and support of teachers in using and adapting iTEC technology, and more specifically in its responsibility to operate the technical support services for national technical and pedagogical coordinators, who will coordinate the national pilots and will serve as the first-line of support for teachers. In that sense, it is closely related to Task 6.1 (establishing training and support structure for national coordinators) and Task 6.7 (setting-up the shared iTEC and iTEC in-service training environment). In those tasks WP6 will make the necessary technical provisions while WP4 will ensure the moderation and human support.

Some commonalities are also found between this document and Task 2.2 (Descriptors of educational change) from WP 2. Both are indeed based on the iTEC need to identify and explore current technological/pedagogical trends and drivers that affect education and that are expected to introduce crucial changes in the educational systems (in its structure, norms, procedures and actors).

### **iv. Structure of the document**

This document presents a framework for the 21st century skills and competences on the use of ICT to be developed by teachers in order to be able to manage the future classroom. The framework is presented in detail in Chapter 1, describing the technical-pedagogical teacher skills in its key dimensions: Digital Knowledge (Technology operations, concepts and theories), Planning and Management, Classroom practices, Professional development and Social & Ethical Domain. This is followed by an example

of teachers competences applied in one learning scenario implementation (from 1st cycle).

Chapter 2 explores pedagogical models for the 21st-century classroom with emphasis on the notion of learning in communities of practice and suggests Project based learning and Game base learning as examples of methodological structuring resources for the implementation of innovative activities in the classroom. Additionally it explores the metaphor of orchestration of classroom activity and its implications for the teaching-learning process.

Chapter 3 presents a review of effective models of teachers' professional development followed by Chapter 4, which focuses on teachers' education and continuous/in-service professional development, considering iTEC aims.

The report closes with Chapter 5 that includes the bibliography referenced in the document and the Analysis of frameworks of 21st century skills as Annex.

## **v. Impacts of the deliverable on the iTEC Project**

This deliverable aims to be used as a guiding document for selecting and publishing online resources for enabling teacher education and to support for the implementation of the scenarios selected (Task 4.4). This document is also expected to inform the different initiatives created to support and cultivate iTEC online community of practice (Task 4.5), where teachers will have access to:

- . shared teaching experiences and peer-based learning opportunities;
- . technical and pedagogical support addressing learning scenarios implementation;
- . relevant educational resources and tools;
- . informal and formal continuing professional development activities.

We also expect that this document could be considered by WP 2 partners, primarily in the development of learning scenarios focused on stimulating teachers training and professional development, and by WP 6 partners, specifically in activities related to the technical and pedagogical support that will be provided to national coordinators, as they are the first source of support to iTEC teachers.

#### **vi. Ethical issues**

There are no ethical issues in relation to this deliverable.

#### **vii. IPR issues**

No IPR issues are related to this document.





# iTEC

Designing the future  
classroom

## Teacher skills and competence development for classrooms of the future

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## Credits

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## 1. TECHNICAL-PEDAGOGICAL TEACHER SKILLS FOR THE CLASSROOM OF THE FUTURE

Facing the challenge of imagining the teachers' skills for the future classroom, we tried to escape the temptation of creating the illusion that we are able to guess what the future classroom will be like and we concentrated on the future classroom as seen within the iTEC Project. For this purpose we assumed that the teacher plays and will play a crucial role in the classroom activities.

To conceive that classroom, 5 descriptors were developed upon the **key technological and educational trends** identified by Work Package 2 for the development of the iTEC learning scenarios (1st cycle). They are included here in order to describe the setting of tomorrow's classrooms.

- **Roles**

- There is an increase in students-centred learning with the teacher building links between the student's interests and the curricula;
- All learners have opportunities to work and collaborate with learners in other places besides the school, as well as with other educators and experts;
- A new concept of 'class' emerges (based on subject / topic of interest, with students from different age-group, from different schools or living in different countries, etc.);
- Teachers become more involved in helping students learn autonomously at their own pace;
- New types of professionals step into the schools (Educational Scientists, Researchers, Financial Managers, Human Resources Technicians, IT, Adult Trainers, online guests from different fields of expertise).

- **Aims, objectives, curriculum and assessment**

- There is an increased focus on 'new media literacies';

- Digital technologies allow schools to use assessment data to personalise their teaching and promote self-paced learning;
  - Teachers use bodies of connected evidence from a variety of media to assess students (peer-to-peer review systems, e-portfolio, external expertise evaluation systems, consultant models, etc.);
  - Teachers focus on promoting the development of '21st century skills';
  - Learners work on projects, doing authentic tasks and using technology creatively to tackle real challenges;
  - More creative approaches are used in education;
  - Schools begin to develop courses and careers advice for a variety of mixed aged learners, including older and younger students and inter-generational learning is explored;
  - Influential corporations and global organisations have agreed standards of 21<sup>st</sup> century skills.
  - New-scientific areas integrate curricula and a) scientific updated curriculum appears and b) multiple-curricula approach arises as personalized learning really takes place.
- **Time and Spaces**
    - Learners are able to access formal education at any place and at any time of the day;
    - Learning spaces are designed to accommodate different learning activities;
    - Classrooms expand as e/b-learning<sup>2</sup> approach increases and a new way of conceptualized classroom emerges. A classroom can be found in a Museum, in a University research lab, in a company, in a library or a local newspaper, etc.
    - Students with special educational needs are taken into account when planning new schools (sensor equipped-classrooms, interactive furniture and technology);

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<sup>2</sup> b-learning stands for blended learning and refers to the mixing of different learning environments. It can for instance combine traditional face-to-face classroom methods and more modern computer-based activities.

- The flow of information between home and school becomes seamless, possibly using digital technologies;
  - The school library becomes a multipurpose learning space.
- 
- **Technology and resources**
    - Collaborative web 2.0 technologies allow learners to learn from each other as part of their formal education experience;
    - Use of interactive touch surfaces, mobile devices and augmented reality technology increases;
    - Schools use technology that can automatically adapt to the ability of the students in order to teach them more effectively;
    - Learners can search across repositories on the web, where contents are categorised and assessed to meet quality and reliability requirements.

Based on these assumptions, this document provides a framework of technical and pedagogical competences to be developed by teachers keeping in mind that the problems of teaching and learning are to be formulated in the domains of people actions and within the school system of activity where technology may be part of the problem and part of the solution.

Three **introductory ideas** are presented in order to clarify the technical and pedagogical skills proposed for teachers:

**1)** The concept of 'skill' is usually understood as an operational construct, that is why it is important to take into consideration the concept of 'competence' instead, which integrates a wider conceptual perspective of thinking. A competence is not limited to functional aspects; it involves skills, knowledge (technical, theoretical and tacit knowledge and understanding), attitudinal and motivational attributes as well as ethical values. The term 'competence' involves knowledge, skills, or abilities as *the means* and effectively performs the activities of a given occupation or function to the standards expected as *the end*. The term competency loses its true meaning if the

end or goal is ignored. It integrates teachers' willingness to mobilise skills and knowledge to meet the pedagogical situations using digital tools and resources based on the beliefs that it can contribute to raise the level of efficiency in the teaching-learning process.

**2)** In a knowledge-based society where life in the social world is becoming increasingly digitalised, the idea of dichotomising teachers' mastery of ICT as 'technical-oriented' and 'pedagogical-oriented' does not seem to be adequate. Being prepared to use technology and knowing how that technology can support students' learning has become integral skills in every teacher's professional repertoire (UNESCO, 2008). An integration of both dimensions is seen as more adequate - technical-pedagogical competences - because each competence will always involve some technical dimension (the mastery of tools or applications), and because it refers to teachers as professionals, and consequently also includes a pedagogical dimension (on a reflective and/or practical level).

**3)** Because today's occupations and jobs already require new skills and because it is expected that the technological development will give rise to quite a number of new careers and entirely new job functions, students will also have to evidence new skills. Those skills are frequently referred as ICT literacy, digital skills or 21st-century skills. From the analysis of thirteen 21st century skills-related frameworks (see Annex 1) the following core competences were identified: Digital skills (technical mastery); Information management; Research, strategic planning and problem-solving, Reflection and critical thinking; Effective communication skills; Collaboration and interpersonal skills; Social responsibility and multicultural literacy, Innovation, creativity & productivity; E-business skills.

If these competences are seen as central both today and tomorrow to promote to students, they must also frame the teachers' competences.

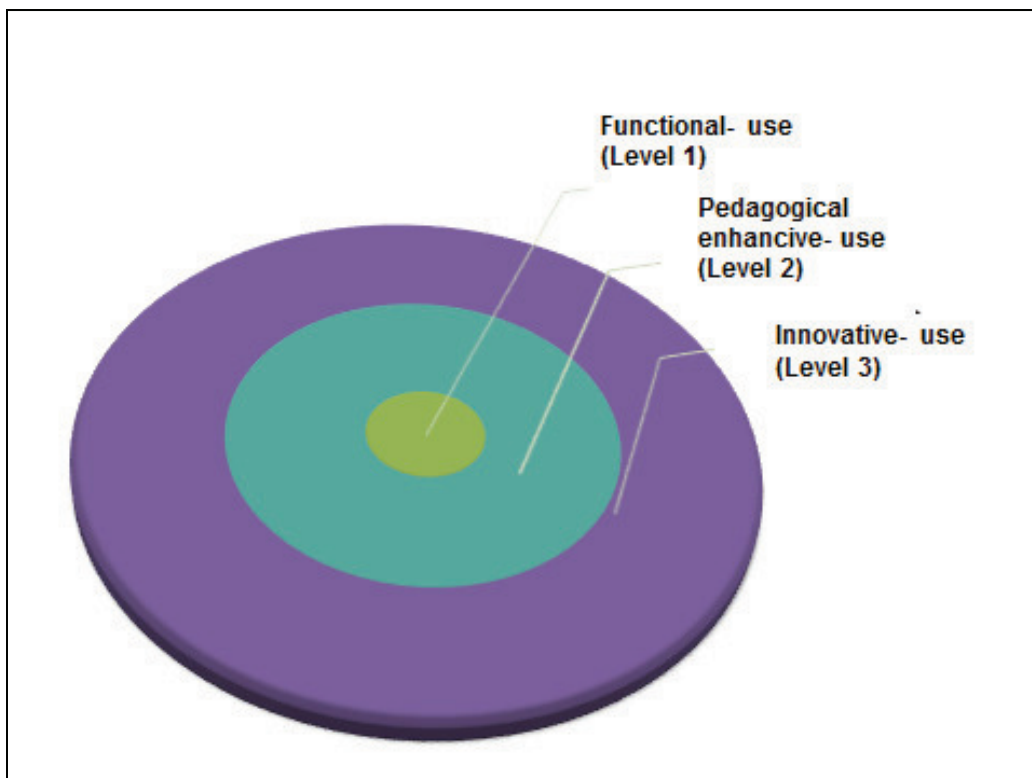
Therefore, for teaching in the classroom of the future, teachers will have to:

- professionally use technologies as 'functional tools' that should be naturalised and incorporated into the various dimensions of teachers' practices, which means that ICT and digital content will be inherently integrated as a teaching resource. This is proposed as **Level 1: functional-use level**.

- see ICT both as a pedagogical enhancer of teaching strategies and as support for students' learning activities, clearly identifying advantages and constraints of ICT use and its potential for transformation. This is proposed as **Level 2: Pedagogical enhancive-use level**.
- allow technologies to undertake an innovative role on their own teaching practices, contributing to stimulate (i) teachers' habits of collaboration and experiences-sharing with peers and other agents of the educational community (in a local, regional, national and international level), and (ii) teachers' professional responsibility and school commitment (through a reflective and investigative perspective). Finally, this is proposed as **Level 3: Innovative-use level**.

These three levels of competence can be seen as hierarchically organised and teachers may achieve only Level I, II or III, but in the near future, the three levels should be fully achieved as they emerge as one.

**Figure 1:** Levels defined for teachers' competences





At the same time, different domains of competences (inspired by literature review and by the analysis of frameworks of 21<sup>st</sup> century skills – Annex #1) are considered in teachers' digital literacy (technical-pedagogical competences), specifically: Digital Knowledge domain, Planning & Management domain, Classroom practices domain, Professional Growth domain and Social & Ethical domain. Each one of those is described in the following pages.

### **Digital Knowledge (Technology operations, concepts and theories)**

It relates to teachers level of ICT proficiency and knowledge about new learning theories and ICT integration models.

Teachers need to demonstrate a reasonable level of proficiency in managing virtual systems, online applications, digital tools and online educational resources and also be able to transfer current knowledge into new technologies and situations.

It also comprises the knowledge of current theoretical models of learning and ICT integration in education-related frameworks.

### **Planning & Management domain**

It is related to teachers needs to plan, manage teaching activities and monitor students' specific progresses and general performance.

Teachers have to critically evaluate and select tools and resources to facilitate planning, developing and managing inspiring activities/projects that will promote students' curiosity, creativity and productivity. This domain integrates the design of innovative and engaging learning experiences (which inherently incorporates digital tools and resources) and its evaluation through diversified and updated forms of assessment (which will require the identification of new potential for assessment beyond its role as an accountability instrument and the exploration of new assessment methods, but within the constraints of national and local requirements).

### **Classroom practices domain**

It refers to the activity of the teacher in the classroom while orchestrating students' actions, initiatives and discourses. It includes class management, content covering, support to student specific needs and engagement promotion.

Teachers should mobilise technologies in order to:

- (i) design learning scenarios that contribute to promote to all students the required skills for a fully informed and active participation in societal issues;
- (ii) personalise learning activities – methods, content, activities and dynamics – and to address students' diverse learning styles and interests, pursuing students' engagement, success and development;
- (iii) consider the learning standards for the different curriculum subject areas, at least as long as the 'curricula-logic' persists, and explore how traditional subject areas, such as Sciences, Maths and Languages, can be updated and taught with clear relationship to the real-world and with high relevance to students.

### **Professional Growth Domain**

It is related to teacher responsibility to evolve as a qualified professional and is consequently associated with attending the required teachers' training initiatives but it also integrates the need to get involved in informal learning opportunities for professional development.

Teachers will have to develop independent efforts to pursue continuous professional development and to keep updating their knowledge of new teaching methodologies and ICT integration into classrooms activities especially the way they can be mobilised to support better collaboration with pupils, their families and the community.

This can be very much connected to regular and proactive use of online learning environments and participation in local and global online communities to exchange ideas and experiences and to get insights for further developments. The development of a personal/school/community-shared vision of technology integration in education is also seen as extremely relevant.

## **Social & Ethical Domain**

This domain relates to teachers sense of awareness about socio-economic, environmental, ethical and legal aspects regarding the triadic relation between technologies, education and society.

Teachers will have to understand local and global societal issues and responsibilities in an evolving digital culture and exhibit safe, legal and ethical behaviour in their professional practices. The development of reflection about digital identity and digital citizenship will also be required.

Society seems increasingly fragmented and more efforts should be put in reflecting and promoting a new value on social and citizenship skills, cultural tolerance and civic responsibility both in real-life and virtual environments.

The way the 3 levels of competences relate to the different domains previously referred is presented in the next table, where specific teachers' skills can also be found.

**Figure 2:** Matrix of teachers' technical-pedagogical competences

	Level 1 Functional-use level	Level 2 Enhancement-use level	Level 3 Innovative-use level
	using technologies as functional tools for teaching and learning	using technologies for enhancing teaching and learning	using technologies for innovating teaching and learning
A) Digital Knowledge (Technology operations, concepts and theories)	<ul style="list-style-type: none"> <li>. using digital tools, online apps and learning systems to create effective oral, written and multimedia content in a variety of forms and contexts (A.1.1).</li> <li>. showing basic notions about perspectives and models of using ICT in teaching and learning (A.1.2)</li> <li>. showing interest in understanding potentialities of ICT in teaching (A.1.3)</li> </ul>	<ul style="list-style-type: none"> <li>. keeping regular contact with sources of knowledge related to educational online apps (A.2.1)</li> <li>. troubleshooting digital tools and apps, and transfer current knowledge to learning of new technologies (A.2.2)</li> <li>. exploring and developing skills in the use of new digital tools, online apps with potential for teaching and learning (A.2.3)</li> <li>. making explicit the pros and cons of models of using ICT in education (A.2.4)</li> </ul>	<ul style="list-style-type: none"> <li>. reveal comfortable level of proficiency in the use of digital tools and online apps and pursuing the mastery of new tools with high-potential for teaching and learning (A.3.1)</li> <li>. purposefully adapting online apps and web 2.0 tools to specific activities according to learning goals (A.3.2)</li> <li>. fluently discussing the innovative role of ICT in education and operationalizing its implications (A.3.3)</li> <li>. experimenting different teaching strategies promoted by new learning theories and conceptual frameworks related to ICT integration (A.3.4).</li> <li>. exploring and/or designing new models of using ICT in the school context (A.3.5)</li> </ul>

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	Level 1			Level 2		Level 3	
	Functional-use level			Enhancement-use level		Innovative-use level	
	using technologies as functional tools for teaching and learning			using technologies for enhancing teaching and learning		using technologies for innovating teaching and learning	
B) Planning & Management domain	<ul style="list-style-type: none"> <li>. using technologies to substitute traditional lesson plans and assessment procedures (B.1.1)</li> <li>. collecting digital resources to be used in teaching, matching specific curriculum standards/topics to particular software packages (B.2.2)</li> <li>. knowing basics about different online apps that could be used for managing teachers activities and students performances (B.2.3)</li> </ul>			<ul style="list-style-type: none"> <li>. planning and organizing activities which productively include the pedagogical use of digital tools (B.2.1)</li> <li>. searching, organizing, critically evaluating and selecting tools and resources to inspire students' learning and creativity (B.2.2)</li> <li>. using online learning systems to have clear awareness and updated feedback from students performances (B.2.3)</li> <li>. exploring different assessment methods (B.2.4)</li> </ul>		<ul style="list-style-type: none"> <li>. conceptualizing and implementing technologies-based design for plan and management of all areas of teacher activity (e.g. mobile tech for assessment, contacts with parents) (B.3.1)</li> <li>. cultivating within the school a culture of sharing resources and supporting teaching and learning as cross-curricular and collective enterprise (B.3.2)</li> <li>. allocating time and effort to explore forms of interpreting and critically interrogating (with technology) the standards of specific subjects within multiple-curricula (B.3.3)</li> <li>. designing and experimenting innovative assessment methods (peer-to-peer, e-portfolio, external expertise evaluation, consultant models) (B.3.4)</li> <li>. fully orchestrating classroom activity keeping control of the learning trajectory of the class as a whole but allowing space for individual initiatives (B.3.5)</li> </ul>	

## D4.1\_Teacher skills and competence development

	Level 1			Level 2		Level 3	
	Functional-use level			Enhancement-use level		Innovative-use level	
	using technologies as functional tools for teaching and learning			using technologies for enhancing teaching and learning		using technologies for innovating teaching and learning	
C) Classroom practices domain	<ul style="list-style-type: none"> <li>. recognizing the role of apps in specific classroom activities, such as support students instruction and assessment (C.1.1)</li> <li>. using online apps for promoting isolated tasks in the classroom (C.1.2)</li> </ul>			<ul style="list-style-type: none"> <li>. implementing instances of online apps together with learning proposals related to students interests (C.2.1)</li> <li>. using ICT to guide and engage learners as well as stimulating students to use specific apps to develop different projects in the classroom (C.2.2)</li> <li>. use ICT to communicate with students, parents and other school educational agents (C.2.3)</li> </ul>		<ul style="list-style-type: none"> <li>. assuming technology as omnipresent in students' practices and take creative advantage of that in the classroom with a clear aim of ensuring quality of delivery (C.3.1)</li> <li>. developing learning activities that stimulates students to make extensive and autonomous use of technology both in classroom tasks and in outside world-based projects (C.3.2)</li> <li>. designing forms of using digital technologies in the classroom that blurs the borders between school and outside-world activity (C.3.3)</li> <li>. use online systems and apps to define new patterns of communication and collaboration with students, parents and other educational agents (C.3.4)</li> </ul>	

## D4.1\_Teacher skills and competence development

	Level 1			Level 2		Level 3	
	Functional-use level			Enhancement-use level		Innovative-use level	
	using technologies as functional tools for teaching and learning			using technologies for enhancing teaching and learning		using technologies for innovating teaching and learning	
D) Professional Growth Domain	<ul style="list-style-type: none"> <li>. using technologies to address individual immediate professional needs (D.1.1)</li> <li>. using the web to get specific subject matter content knowledge, didactic and pedagogical knowledge (D.1.2)</li> <li>. using systems and internet tools to establish practices of communication with colleagues (D.1.3)</li> <li>. evidence openness to get in contact with new educational approaches (D.1.4)</li> </ul>			<ul style="list-style-type: none"> <li>. exploring new teaching strategies and responsibilities related to an increasing immersion of ICT in students everyday life (D.2.1)</li> <li>.pursuit growing levels of professional adaptability and nurturing ones' own curiosity in getting in contact with new educational approaches (D.2.2)</li> <li>. increase the practices of team-teaching and collaborating with colleagues and/or other educational agents within school (D.2.3)</li> <li>. following web-based teachers networks where resources, lessons' planning, legislation, evaluating documents are normally shared (D.2.4)</li> <li>. being involved in school-organized continuous professional development initiatives (formal and informal (D.2.5)</li> </ul>		<ul style="list-style-type: none"> <li>. autonomously monitoring one's own learning needs, assuming ownership of own professional development and defining a personal training path (D.3.1)</li> <li>. increase the practices of teaming and cooperation with other teachers, educational and subject-related experts, parents and other educational agents in the community (D.3.2)</li> <li>. searching and choosing web-based resources to support subject matter deepening and pedagogical knowledge (D.3.3)</li> <li>. actively participating in online communities of practice dealing with specific knowledge domains in education and reflection about teaching as a profession (D.3.4)</li> <li>.pursuit growing levels of professional adaptability and creativity, ability of managing Complexity and Risk-taking in finding and generating new ideas to overcome new educational challenges(D.3.5)</li> <li>. playing a stewardship role stimulating the</li> </ul>	

## D4.1\_Teacher skills and competence development

			adoption of ICT in the school culture (D.3.6)
	Level 1		
	Functional-use level	Enhancement-use level	Innovative-use level
	using technologies as functional tools for teaching and learning	using technologies for enhancing teaching and learning	using technologies for innovating teaching and learning
E) Social & Ethical Domain	<ul style="list-style-type: none"> <li>. referencing information related with data interpretation and reliability analysis as well as online safety, ownership and copy-rights (E.1.1)</li> <li>. assuring that ethical principles are fulfilled in its elementary form (E.1.2)</li> <li>. possessing knowledge related to online identity, ethics and social responsibility (E.1.3)</li> </ul>	<ul style="list-style-type: none"> <li>. stimulating the analysis of impact of ICT in individuals safety, data protection, ownership and identity (E.2.1)</li> <li>. being able to create activities that aims to make students reflect on how technologies interplay with the socio-economic organization of society at a local and global perspective (E.2.2)</li> <li>. making students analyse sources of information, discuss a variety of social and ethical issues emerging from the pervasive use of technology (E.2.3)</li> <li>. pursuing growing levels of global awareness, ethics and multicultural Literacy within classes (E.2.4)</li> </ul>	<ul style="list-style-type: none"> <li>. designing projects to create opportunities for students to exercise independent judgment, critical thinking and solve problems related to social, ethical and legal issues regarding ICT (E.3.1)</li> <li>. assumes critical reflection regarding new web-based markets, its influence on global economy and its repercussions on the education and educational systems (E.3.2)</li> <li>. getting involved in online initiatives with a clear ethical agenda (E.3.3)</li> <li>. cultivating participation in online communities and networks regarding critical interrogation of technology use and its effects on individuals (online) identity (E.3.4)</li> <li>. promoting growing levels of global awareness and multicultural Literacy in a school-level (E.3.5)</li> </ul>



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## **1.1 Fitting teachers' technical-pedagogical competences with iTEC activities**

The previously defined competences are seen as the key-competences required for effectively act as a teacher in the near future. They are organised according to different levels of progression. Most of them are seen as quite useful at the present days but considered as critical for the teachers of the classroom of tomorrow.

The framework of competences defined for teachers aims to describe a **profile** for educators and is mainly focused on the idea that people will be more and more immersed in a rich-media networked learning space where anytime-anyplace learning experiences and stimulating new educational tools, practices and environments will be available. Therefore, the role endorsed by teachers will change, from a 'sage-on-the-stage' to a 'guide-on-the-side' approach. Teachers will have to act as educational providers (one of many others) tailoring their teaching to the needs of each of their students and with respect to the social-economic environment. Teachers will be responsible for ensuring a delivery of quality in the wide variety of educational experiences orchestrated for/with the student.

Teachers show creativity in the way they conceptualize, organise, deliver and assess learning. New approaches must consequently be considered to highlight what students have learnt (knowledge and skills) and what they will be able to amplify with that learning (competences and metacognition).

Teachers must be highly confident professionals, confident about what they are teaching (subject mastery), about how they teach (technology and pedagogy mastery), what they are as teachers (identity and professional growth), what their students are as active and critical citizens and about teaching and its role in the redesign of societies (social and ethical dimension).

Therefore iTEC project activities need to take these teachers' key-competences into account at all levels, whether in the learning stories, the prototypes, the iTEC environments, the support services, the assessment tools, or the online community of practice .

In the iTEC project the following points will consequently need to be addressed:

- stimulating the development of all these technical and pedagogical competences for teachers, mainly with designing a) 'pilottable' but pedagogically challenging scenarios and b) technically easy-to-use but powerful web tools, systems or applications that call for the use of these different competences;
- supporting the maturation of these competences within the online community of practice, by providing proper online support, useful resources and tutoring services, as well as continuous professional development opportunities;
- promoting the iterative evaluation of the teachers' level of confidence in their technical and pedagogical competences by providing tools, identifying critical moments and promoting opportunities for teachers to recognize personal progression made through their participation in the project. For instance, an interactive self-report questionnaire could help teachers map their technical-pedagogical skills, attitudes and expectations, as well as monitor their own learning).

The teachers' online community of practice should be an environment that runs both formal and informal continuous professional development actions, using tools and services that help build the skills required from educators of the twenty-first century.

The role of the iTEC teachers online community is crucial in (i) providing prompt technical and pedagogical advice, (ii) identifying and meeting teachers' individual needs, (iii) overcoming teachers' sense of isolation, which seems to be a critical idiosyncrasy of the specific group of professionals, (iv) helping novice and experienced teachers to become confident educators, mainly through the implementation of innovative practices and the sharing of their experiences, resources, difficulties and successes, etc., (v) serving as the empirical field to produce evidence of the skills being developed by the teachers and (vi) monitoring

the implementation of the school pilots. This online space could promote a sense of community and a shared vision about what will be requested from the educators of tomorrow. It can also highlight the ways teachers can seize opportunities for integrating 21st century skills, tools and teaching strategies into their classroom practice — and help them identify what activities they can replace/de-emphasize. It can also promote teachers' self-esteem and sense of professional self-efficacy mainly via online professional development initiatives (classroom-focused in service training).

Research indicates that many teachers believe they truly benefit from engaging in valuable informal learning experiences. This learning has the potential to impact on the effectiveness of teachers' formal learning experiences, but also on what teachers do in their classrooms, and possibly on their students' learning. Moreover these informal learning experiences could also provide a continuing follow-up that is usually lacking in other formal training programmes due to their limitation in time and partially explains their ineffectiveness.

## **1.2 Teachers' competences in learning stories implementation: an example**

In order to clarify how the previously defined competences for teachers may relate to teachers' practice in the classrooms of the future one of the iTEC pre-pilot learning scenarios was randomly selected: 'Out of school matters'.

For this specific learning story this document identifies:

- 1) Types of activities that are inherently involved in its implementation;
- 2) Examples of resources to support the implementation of the learning story;
- 3) Teachers' competences relevant to the implementation of the learning story.



### **“Out of school matters’ scenario”**

[http://itec.eun.org/c/document\\_library/get\\_file?p\\_l\\_id=18097&folderId=18123&name=DLFE-742.pdf](http://itec.eun.org/c/document_library/get_file?p_l_id=18097&folderId=18123&name=DLFE-742.pdf)

Students in their daily life learn things that will help their personal development. “Out of School Matters” is a way of recognising the knowledge gained through experience.

This learning story aims to link home and school learning and thus provides opportunities for student’s informal learning and achievements to be acknowledged in school, and maybe beyond (e.g. student’s resume). Students have consequently to document their informal learning and to upload the “proofs” and related materials onto a portfolio. They can use this portfolio to share their learning with teachers and parents when appropriate. They can also reflect on the learning they have achieved through their informal activities.

Out of school activities i) allow students to share their knowledge with the entire school community; ii) involve students in real tasks that make sense for them; iii) encourage schools to recognise and accredit formal and non-formal learning; and iv) create a global product with the individual participation. Students share their knowledge. It is then the responsibility of the school to legitimise, recognise and value the knowledge acquired and developed outside.

To recognise and accredit informal and non-formal learning it is important that teachers have some information about what their students do outside the school. The teacher might start by asking students about their free time and hobbies trying to find out their motivations, interests, expectations and future prospects.

**Figure 3: 'Out of school matters' scenario (activities and support resources)**

Type of activities	Definition	Resources
Supporting students projects: planning & supervision	Defining a 'research problem', defining activities, resources and work strategies, collecting data, analysing data, identifying results and drawing conclusions, developing multimedia presentations	<a href="http://docs.google.com">http://docs.google.com</a> <a href="http://www.teamlab.com/">http://www.teamlab.com/</a> <a href="http://www.zoho.com/projects/">http://www.zoho.com/projects/</a> <a href="http://www.ganttproject.biz/">http://www.ganttproject.biz/</a>
Designing and managing multiple working groups	Forming teams, defining goals and responsibilities, defining tasks that require interdependencies, helping students to divide the work, making the work relevant for each student of the group, identifying individual achievements and group accomplishments	<a href="http://www.google.com/reader/">http://www.google.com/reader/</a>
Collecting real-life data and sharing resources online	Storing and managing files and multimedia products in a shared online space	<a href="http://www.masher.com/">http://www.masher.com/</a> <a href="https://www.dropbox.com/">https://www.dropbox.com/</a> <a href="http://www.4shared.com/">http://www.4shared.com/</a> <a href="http://www.foliocloud.com/pt/">http://www.foliocloud.com/pt/</a>
Working collaboratively with teachers and other educational agents (national/international experts, parents, community)	Managing other teachers' collaboration, selecting and involving different stakeholders in learning and teaching activities	<a href="http://sync.in/">http://sync.in/</a> <a href="http://vyew.com/s/">http://vyew.com/s/</a> <a href="http://www.skype.com">http://www.skype.com</a>
Innovative and collaborative assessment	Stimulating formative and continuous evaluation, Portfolio-based assessment, evaluation of outcomes and processes, supporting students self-assessment and evaluation of their group's effectiveness	<a href="http://mahara.org/">http://mahara.org/</a> <a href="http://www.wikispaces.com/">http://www.wikispaces.com/</a> <a href="https://www.blogger.com/">https://www.blogger.com/</a>

In the implementation of this learning story, the teacher assumes the role of mediator of the learning process, who accompanies and guides the student in building the portfolio through problem-solving or project-based learning approaches.

The teacher has to guide the students through the evaluation of their experience outside the school and to help them project the results of this experience in the school on a retrospective and prospective scale. In this process, the teacher is a guide, an encourager, a consultant, an advisor and simultaneously a resource. The teacher directs and stimulates the horizontal and reciprocal relationship between the students as key actors of the learning process and assumes the role of an advisor who positively reinforces the skills and encourages the involvement of students in the learning process.

The following table identifies the teachers' technical-pedagogical competences needed for implementing the 'Out of school matters' learning story.

**Figure 4:** Teachers competences for 'out of school matters' scenario implementation

	Level 1 Functional-use level	Level 2 Enhancement-use level	Level 3 Innovative-use level
A) Digital Knowledge (Technology operations, concepts and theories)			<ul style="list-style-type: none"> <li>. experimenting different teaching strategies promoted by new learning theories and conceptual frameworks related to ICT integration (A.3.4).</li> </ul>
B) Planning & Management domain	<ul style="list-style-type: none"> <li>.using online learning systems to have clear awareness and updated feedback from students performances (B.2.3)</li> </ul>	<ul style="list-style-type: none"> <li>. planning and organizing activities which productively include the pedagogical use of digital tools (B.2.1)</li> <li>. using online learning systems to have clear awareness and updated feedback from students performances (B.2.3)</li> </ul>	<ul style="list-style-type: none"> <li>. exploring different assessment methods (peer-to-peer, e-portfolio) (B.3.3)</li> </ul>
C) Classroom practices domain		<ul style="list-style-type: none"> <li>. implementing instances of online apps together with learning proposals related to students interest (C.2.1)</li> <li>. using ICT to communicate with students, parents and other educational agents (C.2.3)</li> </ul>	<ul style="list-style-type: none"> <li>. developing learning activities that stimulates students to make extensive and autonomous use of technology both in classroom tasks and in outside world- based projects (C.3.2)</li> <li>. designing forms of using digital technologies in the classroom that blurs the borders between school and outside-world activity (C.3.3)</li> </ul>
E) Social & Ethical Domain		<ul style="list-style-type: none"> <li>. designing and implementing activities aiming to show students how technologies interplay with the social world (E.2.1)</li> </ul>	<ul style="list-style-type: none"> <li>. promoting growing levels of global awareness and multicultural Literacy in a school-level (E.3.5)</li> </ul>



## **2. PEDAGOGICAL MODELS FOR THE 21-CENTURY CLASSROOM**

While addressing the design of the classroom of the future the perspective that considers learning as an integral part of social practices (Lave & Wenger, 1991) was favoured. This means that learning is at least partially taken as a social co-creation within communities of practice, assuming that knowledge exists in the practice of those communities (Matos, 2010). We understand learning (and thus knowledge) localized in processes of social co-participation and not in the individual. Instead of focusing our attention on discrete bodies of knowledge to be transferred from one who 'knows' to one who does 'not know', attention turns to the possibility of participation in situations where sharing meaning and common understanding are defined in relation to contexts of action and not to mental (or just linguistic) self-contained structures (Matos, 2010). Participation in a social practice where knowledge exists (a domain of practice such as teaching science in secondary school) is an epistemological principle of learning; the social structure of the practice, the inherent power relations and the conditions of legitimacy define the possibilities of participation and thus of learning. Thus talking about learning as participation entails the idea that learning is an integral part of practices in the social world (Lave & Wenger, 1991).

That rationale opens room to other pedagogical models based on (i) a constructionist way of conceptualising teaching and learning aligned with a constructivist interpretation of being, and (ii) a socio-cultural positioning that takes social interaction as the primary source of development through collaborative and team-based activities.

A number of documents present different 21st-century skills frameworks aiming to highlight the diverse competences that tomorrow's schools will have to promote. The analysis of the frameworks of thirteen 21st-century skills documents shows that the

following skills/competences are present with the higher level of frequency: Metacognitive skills, Creativity and innovative attitudes, Digital literacy Skills, Productivity and Accountability, Effective communication skills, Information management fluency, Collaboration skills Inquiry, Critical Thinking, Problem-Solving and Decision-Making (see Annex #1).

Also important for employers in many jobs is a set of attitudes towards work, such as honesty and reliability. These domains are influence skills, literacy, self-planning, numeracy, physical skills, checking skills, problem-solving and external communication skills.

However, a European Schoolnet's recent report on Digital Competence integrated in the National Curricula for Students and Teachers evidences that knowledge and skills for digital literacy are rarely integrated in the Curricula of Initial Teacher Training graduate programmes. Also pedagogical use of ICT in the teaching of subjects is rarely offered (Balanska & Gertsch, 2010).

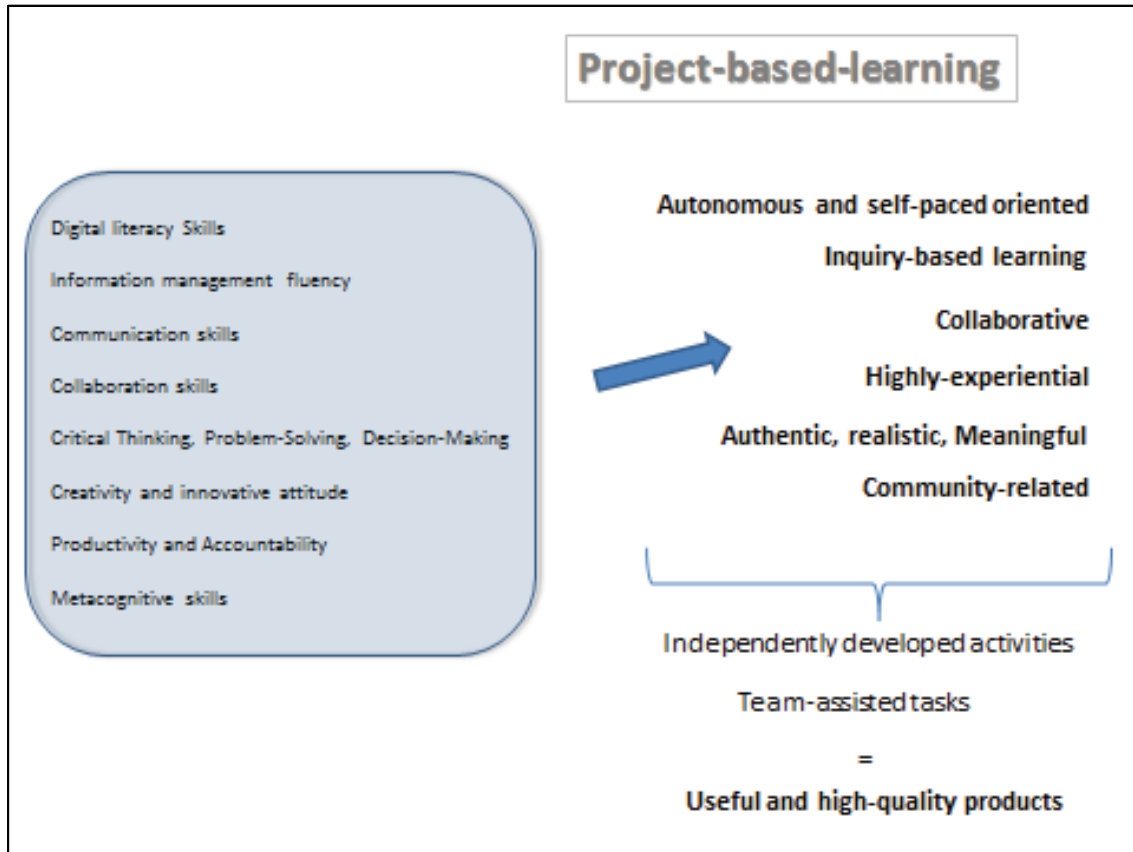
Implementing new classroom practices that effectively contribute to promote the development of citizenship for the future society demands that we stress the need for an alignment of the pedagogical models. Those models will drive iTEC learning stories and the development of tools/resources with the skills that we see as being required in the future.

Teachers' efforts should be concentrated on promoting students' ability to individually access, integrate and evaluate information and plan, manage, assess and critically regulate actions to produce answers to specific problems. Among the relevant skills to promote we need to stress individual adaptability, managing complexity, decision-making and self-direction.

In the school of tomorrow, students will be invited to develop projects and network with other students in order to create the concrete solutions to problems in the form of products of various combined formats (paper, text, images, audio, video, and multimedia). The concrete problems will derive from the analysis made by the students of the situations to be problematized. From this analysis objects and ideas

will be produced that the students will use to transform the problem situations and progress towards solutions while giving meaning to concepts and processes used in that activity. Students' activity can benefit from resources that may help them to apprehend the problem from the very beginning of its formulation until reaching sustainable solutions. This general teaching strategy may include moments when students work independently, periods when the teacher presents information and produces explanations to students in a rather explicit and direct form (or redirects students to relevant video resources where information is provided e.g. through lectures) but also moments when students share their conclusions with their peers, produce conjectures about solutions and substantive theories and come to conclusions that actually approach the exact and rigorous repertoire of science and mathematics.

One example of powerful learning environments for engaging learners draws on the idea of connecting the main activity to be developed in relation to local or global problem situations with local instances. Making sense of the situation, formulating the problem and devising a plan to address it may create the right opportunities to engage in data collection and data analysis, therefore producing the conditions for significant learning to occur. Authentic, meaningful and community-related learning scenarios are to be designed and adapted to local constraints, typically in the form of full-scale problems representing real-world situations.

**Figure 5: Project-based learning model**


Taking **Project-based learning (PjBL)** as an example. PjBL is a teaching-learning methodology that integrates the characteristics previously referred to and constitutes a structuring resource to be used by the teacher with the students. Buck Institute for Education (2011) defines PjBL as a systematic teaching method that engages students in learning and life-enhancing skills through an extended, student-influenced inquiry process structured around complex, authentic questions and carefully designed products/tasks. In project-based learning, learning is contextualized, creative and shared. A PjBL approach tends to create the conditions and need to jump into seeking information, analysing it and selecting the adequate resources, developing and producing accounts, etc., and within that taking on-board not only content and basic skills but also advanced strategies of problem solving. Students

collaborate on projects that require critical thinking and communication. By making learning relevant to them in this way, students' engagement reaches new levels. This higher level of engagement is associated with better educational outcomes.

The teacher starts by giving the students a vision of the type of final product he expects and that requires domain-specific knowledge and concepts, creating in that way a context and motive to act, understand, transform and produce ideas (concepts and procedures). Skills such as collaboration, communication, critical and creative thinking are to be explicitly referred to by the teacher when making a reflection with the students regarding the process of consciousness that is crucial to meaningful learning.

The focus of the design of the activity should be on student inquiry and collaboration, the teacher having a significant role in the process of orchestration (Dillenbourg, 2011) of the classroom activity. The metaphor of orchestration seems to be rather relevant to address the methodology that the teacher uses with the class and to help understand how the teacher of the 21st century acts.

However, the metaphor of orchestration can also be used to explore the issue of the need to accommodate a variety of technologies available such as interactive white boards, smartphones, etc. which constitute a complex ecosystem that cannot be autonomous and automated. "It requires, and that's a positive point, an active teacher able to intervene at any time to change activities, to modify the timing, to re-composes groups, to prompt unproductive students and to maintain expectations." (Dillenbourg, 2011, p.1).

Orchestration is about managing the workflow of actions, both planned and improvised, integrating the initiatives, subjective views and contributions in harmony towards clear and explicit objectives. The teacher is expected to have both the ability to provide guidelines and to setup objectives that students should adopt and adapt to their own learning styles and trajectories.

Technology plays a major role in orchestrating the activity in the classroom. It is useful to distinguish orchestration technology from orchestrable technology

(Dillenbourg, 2011). Orchestration technology refers to technology that supports the actions of orchestrating; orchestrable technology refers to technology which use can be planned in specific cycles or phases of the classroom activity or simply used because an opportunity emerges and it is at hand. It is the responsibility of the teacher to decide to include in the design of the activity the specific uses of certain technologies and to anticipate ways of orchestrating their uses together with other resources and with respect to timings, teaching strategies, pedagogical objectives, classroom organisation, etc. All those elements are part of the design of the classroom activity.

PjBL may serve as an example of a methodological structuring resource to organize specific phases or cycles of activity in the classroom for learning to happen. Learning is seen as emerging at the horizontal level of interactions (student-student) gaining form through student active manipulation of artefacts (tangible and conceptual) and in constructing a significant product (an outcome). Within the process of dynamic transformation of conceptual objects (ideas), the students' action upon ideas and concepts is mediated by a number of elements. We identify as relevant elements of mediation:

- the teacher discourse (including actions, gestures, talk, prompts, etc);
- the available technological artefacts;
- the goals and objectives indicated by the curriculum and/or setup by the project itself.

However, there are other processes of mediation included in the classroom activity system such as (i) the norms and rules (of the practice) that mediate the relationship between the community and the particular student in action, (ii) the different responsibilities and status that mediate the relationships between the community and the ideas and concepts being acted by students with relevant implications in the negotiation of meanings that can be accepted and legitimized according to scientific canons.

Another example of methodological structuring resource that can be adopted in the classroom is **Game-Based Learning** (GBL). We take the notion of game as a framework made up by a specific setting, a set of rules, goals and in certain cases a few constraints that act as stimulus to overcome situations and achieve the specific objectives and goals. This kind of framework usually allows people to experiment the joy of being in control, the pleasure of achieving a certain goal (in some cases winning against others) and to understand the notion of progress towards a new situation and the joy of completeness.

An open-ended learning environment where students are immersed within a framework based on gaming, would involve students in (i) selecting or creating relevant resources and strategies, and (ii) developing significant and applicable skills.

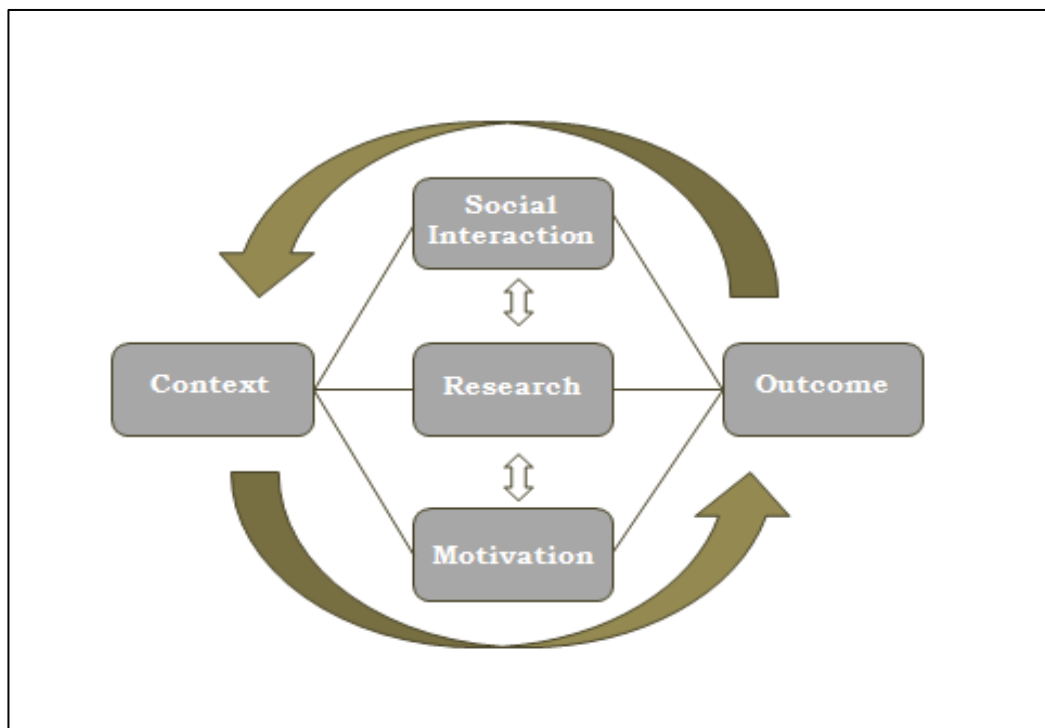
GBL literature (e.g. Gee, 2007) discusses how games may act as structuring resources for teaching and how they provide opportunities in promoting learning. Game players develop their skills by virtually learning things - to fly airplanes, to drive fast cars, to be war fighters, civilization builders, and veterinarians. For instance they learn to understand and compare information from many sources and make decisions quickly; to deduce a game's rules from playing rather than by being told; to create strategies for overcoming obstacles; to understand complex systems through experimentation (Prensky, 2000).

We identify several elements that feature an activity in a GBL: i) keeping the score, winning objects or conditions which provide assessment of the players' performance and thus motivate them; ii) engagement – when the players start the game, they tend to stop only when the game is over – challenge and control are strong reasons for not stopping and go all the way long; and iii) immediate feedback, players receive points and sometimes descriptive feedback during the game.

Finally, a conceptual map highlighting the key elements of the learning scene of any classroom can be considered while equating how teachers can be prepared to engage students in meaningful activity in the school (see figure 6):

- Context - learning situations should always be considered against specific social and local contexts.
- Social interaction - the basis of any activity system (people acting within networks upon specific objects and with specific goals) generating instances of communication and providing conditions for collaboration.
- Research focus - putting informed reflection as a gateway to improvement and innovation in designing learning.
- Motivation - finding ways to get students engaged in the activity proposed and assuring that the motives for action have a sustainable nature.
- Outcomes - derived from students' activity through the construction of relevant products as reifications of the conceptual development made.

**Figure 6:** Key-elements of new pedagogical models





There is a need to promote and stimulate learner activity and upholding meaningful, situated and expansive learning. To manage the classroom's system of activity the teacher both designs and plans but also orchestrates actions in real time. Technology is an inescapable element of mediation in the activity of students while acting upon ideas and concepts and transforming them. Therefore, higher digital competences are required from teachers in connection to the ability to provide objectives, proposals and guidance and to orchestrate students' actions in the classroom.

### **3. EFFECTIVE MODELS OF TEACHERS' PROFESSIONAL DEVELOPMENT**

An analytical approach was undertaken to investigate European tendencies in national policies regarding ICT in educational programmes. This was developed by analysing the Country Reports available online in the INSIGHT/Observatory for new technologies and education<sup>3</sup>.

The desk-based research focuses on the following dimensions:

- ICT Competence targets,
- Assessment schemes,
- ICT in teacher education,
- Training the teachers training, of the 14 Ministry of Education [MoE] involved in the iTEC Project: Belgium, Denmark, Estonia, France, Hungary, Italy, Israel, Lithuania, Norway, Portugal, Slovakia, Switzerland, Turkey and United Kingdom.
- Examples of practices of 'Training the teachers trainers' programmes

#### **ICT competence targets**

Through the analysis of information available on the online platform Insight - Observatory for new technologies and education - a set of principles and trends on ICT Competence targets dimension were found.

Based on data collected in the benchmarks analysis, there is a compelling set of generally common skills. Eight MoEs have defined ICT competence targets; additionally Norway also presents targets set for ICT competence for teachers

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<http://insight.eun.org>

related to use in subjects, but no standards or targets aiming the teachers' overall competence.

The table below presents some examples of competence targets:

**Figure 7: Competence Target**

<b>Competence Target</b>	<b>Number of Countries where it is referred</b>
Teacher is able to:	
Apply systematically and reasonably technology in teaching and learning methods.	10
Use ICT tools purposefully.	9
Prepare resources appropriate to various audiences and teaching situations whilst adhering to the rules of communication.	7
Follow best practices in the use of web-based information and intellectual property.	7
Use ICT creatively to individualize his/her subject's teaching and learning content.	6
Use ICT to support students and/or groups of students with their plans for producing or searching for information.	6
Create electronic and web-based learning materials.	6
Identify ICT resource people and their respective roles, both in the college or establishment and externally (area, market area, society/academy, national level, etc.).	4
Use ICT-based active and project-based learning and methodologies and integrate them into subject teaching processes.	3
Use ICT based organization of the learning processes (cooperation based learning-organisation, project based education).	3
Design opportunities for learners to develop their literacy, numeracy, ICT thinking and learning skills, appropriately with their phase and context.	1
Use ICT based constructivist pedagogy.	1

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Based on the data collected we can provide a clear baseline description of the competence targets for ICT. A trend indeed emerges from the fourteen MoEs analysed: the majority refers to the need of reflection and of open discussion about pedagogical approaches and innovative teaching methods, in straight relation to the subject-specific curriculum.

Therefore the didactic and pedagogical aspects and the adequacy to curricular subject-related ICT use are seen as more relevant than mere tool-mastery.

Ten of the fourteen MoEs show the need of using ICT tools purposefully and of applying them systematically and reasonably in teaching and learning methods. They also refer to the importance of preparing appropriate resources and teaching situations for various audiences and finally highlight the need to follow best practices in the use of web-based information and intellectual property.

Six MoEs also underline the need to research, organise and develop digital resources.

## **Assessment schemes**

Only four of the fourteen countries refer to assessment or accreditation schemes for teachers' ICT competence, namely Portugal, France, Lithuania and United Kingdom.

Those countries define a different rating system, which seeks to structure a set of standards that teachers should follow in order to obtain the certification.

**Figure 8: Assessment schemes**

<b>Country</b>	<b>- Assessment Schemes</b>
France	<ul style="list-style-type: none"> <li>- IT certificate - C2i level 1 - mandatory to enter teacher training institutes;</li> <li>- ICT is part of all initial training;</li> <li>- Government sets training areas and framework;</li> <li>- ICT training is cross-sectorial, and is provided as a distance- and self-training along with onsite training in order to ensure minimal disruption of the school.</li> </ul>
Lithuania	<p>Teachers are encouraged to make their own electronic portfolio (e-portfolio), if they want their educational ICT competences to be accredited.</p> <p>Teachers' educational ICT competences are assessed at three levels:</p> <ul style="list-style-type: none"> <li>- Level 1: Teachers have to know ICT tools and be able to use them in order to enrich the traditional educational process.</li> <li>- Level 2: Teachers are able to plan, organise and evaluate their own activities while applying ICT. They improve the educational process by using ICT, paying much attention to computer networks in a constructivist-learning paradigm (integrated learning, project-based learning, collaborative learning).</li> <li>- Level 3: Teachers help their colleagues and actively participate in the dissemination of their experience with ICT application in education in their school, town, region and country.</li> </ul>
UK	<p>There is no national assessment system, although each school provides methods for assessing ICT competences, through discussion, planning, objective setting and classroom observation.</p>

Portugal	<p>The monitoring of ICT competences training and the certification system are conducted within the scope of the Technological Plan for Education.</p> <p>Teachers' educational competence is assessed at three levels:</p> <p>Level 1: Digital competences certification.</p> <p>Level 2: ICT pedagogical and professional certification.</p> <p>Level 3: Advanced educational-ICT competences certification.</p>
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Three trends clearly stand out from the data analysis from these four countries: Lithuania and Portugal structure the ICT skills certification in a national referential defining three certification levels. The first level refers to digital competences, the second refers to ICT use in pedagogical and professional contexts and the third specifies advanced competences in educational use of ICT (e.g. to develop innovative teaching practices using ICT, to reflexively evaluate his/her own professional experiences and practices and to engage in shared and collaborative activities with the educational community).

In UK, although there isn't a national assessment system, every school has to provide methods for their teachers to be able to assess their own ICT competences. A clear framework as well as a self-review questionnaire was developed by BECTA (2010), making a distinction between three main areas: teaching and learning, planning and administration, assessing and reporting.

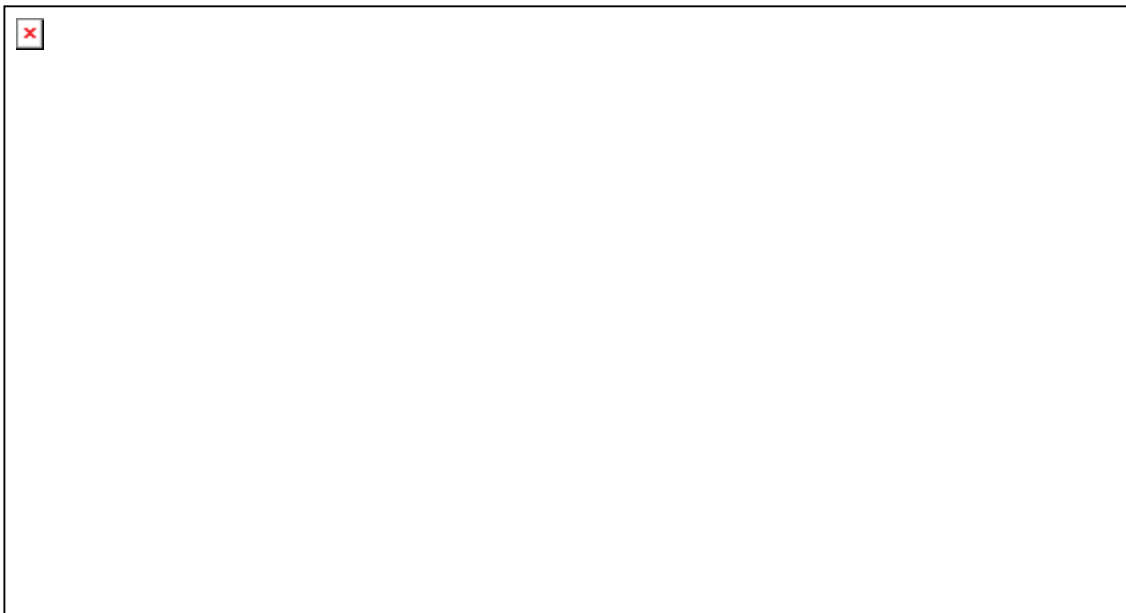
On the other hand in France the IT certificate [C2i level 1] is mandatory to enter in teacher training institutes, making ICT part of any initial training.

## ICT in teacher education

From the analysis of data provided by the fourteen MoEs there seems to be three major trends regarding the integration of ICT in teacher education: i) ICT as integrated into teacher education, ii) ICT as not compulsory in teacher education and

iii) ICT as part of the initial teacher education, even if not compulsory. The figure below refers to that distribution.

**Figure 9:** ICT integration in teacher education (per country)

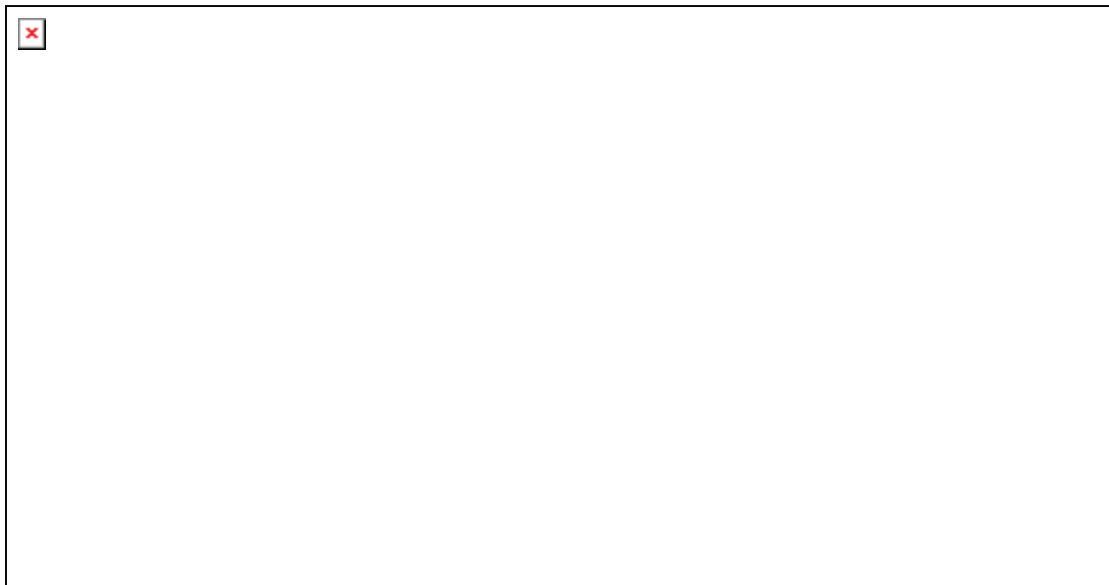


Therefore, there is a larger set of countries where ICT is part of the initial teacher education, even if not perceived as mandatory. Countries as Switzerland, Estonia, Norway, Italy or Hungary include several hours of ICT training and learning in initial teacher training. Other MoEs (Portugal, UK and France) report that ICT is explicitly present in initial teacher training, being essential for the development of teachers' professional skills. No information was found related to Continuous Professional Development (CPD) training.

## Training the teacher trainers

The analysis of this dimension is crucial for apprehending the training pattern in different European countries. An analytical scrutiny of those results shows that there is a set of trends on the training of teacher trainers, although no clear framework seems to exist in the considered countries. But, some of them tend to have a skeletal structure of a training system even though not systematically formalised at the national level, as shown in the graphic below:

**Figure 10:** Training system for teacher professional development



Switzerland, UK and Israel have a formalised system of training the teacher trainers, although that system doesn't have a national scope. On the other hand, Portugal, Hungary, Italy, Estonia and France have a formalised national system of training the teacher trainers. In Lithuania a public-private partnership gathers the MoE and other private entities.

From these results, clear difficulties seem to appear in many countries, in guaranteeing (i) an appropriate qualification of teacher trainers and (ii) a structured and shared vision of the topics and methods that should be covered in teachers' professional development programmes regarding ICT integration in teaching and learning.





### **3.1. Examples of Practices: ‘Training the teacher trainers’ programmes’**

Through research conducted in several documents, reports and sites some countries have examples of good practices related to ‘Training the teacher trainers programmes’. The examples analysed show the need for professional development programmes that would (i) provide teachers with contextualized learning experiences, (ii) focus on use of ICT to achieve learning outcomes, (iii) be flexible and (iv) be pedagogically and technically supported, creating, for example, communities of practice.

#### **ECDL - European Computer Driving Licence**

European Computer Driving Licence Foundation [ECDL] (<http://www.ecdl.org/>) was established in 1997, as a not-for-profit organisation, with the support of European Commission. The foundation is responsible for certifying international computer skills and for enabling the use of Information and Communication Technology (ICT) in individuals, organisations and society.

The ECDL Certification programme consists in a 13 modules, which define the skills and competences necessary to be a proficient user of a computer and computer applications:

Module 1 - Concepts of Information and Communication Technology (ICT)

Module 2 - Using the Computer and Managing Files

Module 3 - Word Processing

Module 4 – Spreadsheets

Module 5 - Using Databases

Module 6 – Presentation

Module 7 - Web Browsing and Communication

Module 8 - 2D Computer-Aided Design

Module 9 - Image Editing

Module 10 - Web Editing

Module 11 - Health Information Systems Usage

Module 12 - IT Security

Module 13 - Project Planning

In each module teachers work with a practical programme of up-to-date skills and knowledge areas which are validated by a test. Training is provided for each module prior to taking the test and includes training manuals and e-learning programmes (<http://www.ecdl.org/programmes/index.jsp?p=102&n=108>).

After the candidate/teacher completes the appropriate number of modules, the approved test centre informs the national operator and the certificate is awarded to the candidate.

In order to achieve a solid base of skills and knowledge, therefore attaining a minimum level of digital literacy, ECDL system recommends that teachers (and other) complete a minimum of four ECDL modules.

## **European Pedagogical ICT Licence (EPICT)**

EPICT ([www.epict.co.uk](http://www.epict.co.uk)) is one of the very few, if not the only, transnational approach to professional development in the pedagogical application of ICT in teaching and learning. It is a comprehensive, flexible and efficient in-service training course introducing a European quality standard to the continued professional

development of teachers in the pedagogical integration of information, media and communication technologies (ICT) in education. It is based on the following ideas:

- Importance of practice: a course during which teachers develop and - as far as possible - try out one or more of the learning scenarios with their own classes.
- Teamwork and cooperation: developing teamwork and exchange of information and best practices among teachers from the same school - to ensure school development (a learning organisation).
- Facilitation process: developing skills and understanding by providing targeted feedback.
- 'Anchoring' the skills developed by giving course participants time to reflect, try out, discuss and reflect again on the ways in which ICT can be used in teaching.

EPICT competency framework is divided into the following categories of general and specific competences:

- Pedagogical competences: planning for teaching and learning, teaching practice, pedagogical reflection, and pedagogical theory.
- Information competences: search and retrieve, information processing, presentation.
- Communication and collaboration competencies: digital communication, collaboration.
- Organisational competencies: organisational development.

EPICT was developed for all the European countries and it has been established as the national reference in a significant amount of countries, such as Denmark, Austria, Albania, Sweden and Ireland.

**eTwinning Project: teachers' professional development dimension**

Running since 2005, eTwinning ([www.etwinning.net](http://www.etwinning.net)) is a European project that promotes school collaboration through the use of ICT between European schools by providing support, tools and services to facilitate the formation in any subject area of short or long-term partnerships between schools, teachers and students.

From a survey conducted in late 2008, with nearly 13,000 e-Twinning teachers from different countries, it was found that one third of the respondents said they signed up for eTwinning to improve their teaching skills. Moreover, more than 75% of the respondent teachers stated that their eTwinning project had had an impact, or even a high impact, on improving their ICT skills, communication skills, teaching skills and interdisciplinary working skills, as well as learning about new teaching methods (Vuorikari, 2010).

eTwinning reveal to have a great potential to improve teachers' continuous professional development and lifelong learning at the European level as well as national and local level, not only for its formal teachers' training initiatives but also, as mostly, by its informal activities. eTwinning offer multiple forms of professional development opportunities, from very formal offers such as national online courses and seminars, professional development workshops and learning events to more informal ones, such as project work and online eTwinning groups, communities of like-minded teachers where plenty of opportunities arise for its members to participate in "informal dialogue to improve teaching" (Vuorikari, 2010).

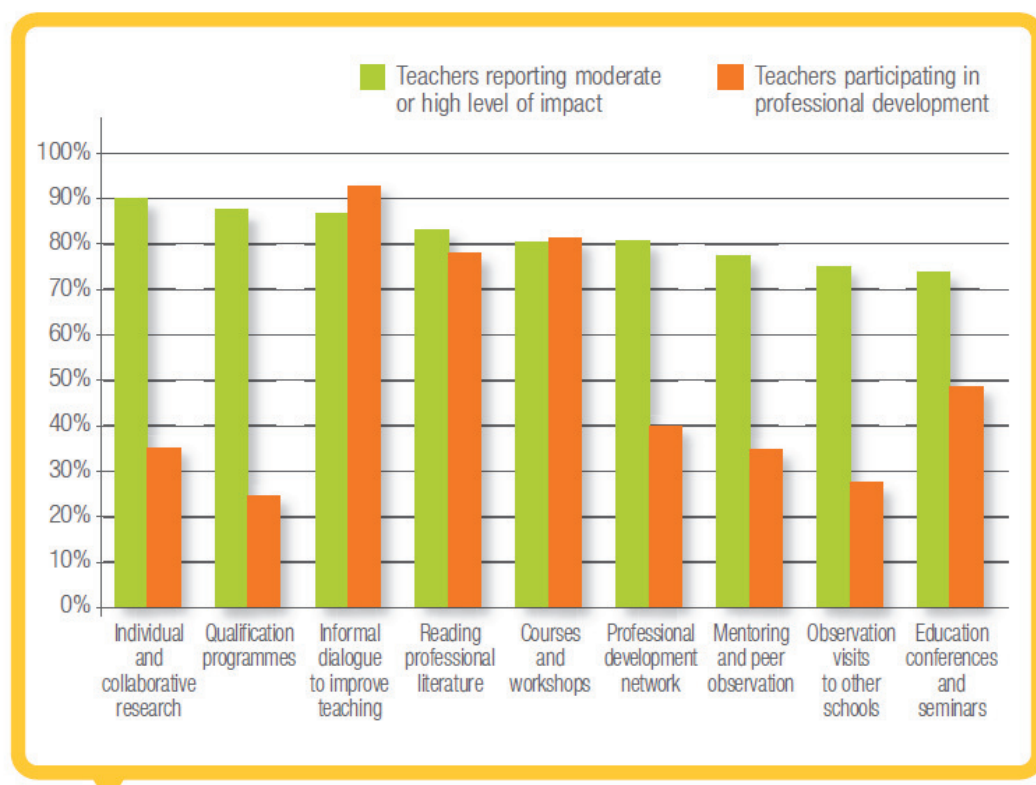
This second part, the informal learning, is one of the particular aspects that makes eTwinning a relevant practice for rethinking teachers' professional development programmes. eTwinning, by its professional development network, has been identified has a high potential project to satisfy in innovative ways some of the teachers' professional development needs in Europe.

Establishing and acknowledging eTwinning as a teachers' professional development network that gives opportunities for a variety of professional development activities

could enhance eTwinning status among the other professional development activities offered in all the participating countries.

OECD's report (TALIS, 2009) finds that “informal dialogue to improve teaching” is mentioned as the most common activity for professional development with a participation rate of over 90% in most countries. Interestingly, teachers also report that participation in informal dialogue has a moderate or high level of impact on their professional development as presented in Figure 11.

**Figure 11:** Teacher professional development initiatives impact



**Country study: Italy**

Since 2001 Agenzia Nazionale per lo Sviluppo dell'Autonomia Scolastica [ANSAS] has developed several programmes to support initial and in-service training for school personnel (Tosi, 2007). For example:

**DiGiscuola**

DiGiscuola started in 2007/2008 as a pilot project aiming to “introduce digital contents in the classroom by exploiting the potential of the interactive whiteboard” (Carro, Parigi & Tosi, 2009, p.3).

The courses related to this project had a blended learning structure: first, a two-day seminar was organised where the teacher trainers met the National Agency researchers and their respective e-tutors. During that seminar the teacher trainers started to work on a set of activities (training agreement, familiarisation with the portal, contents and phases of training). After, those activities were continued at distance in an online environment, with the support of the tutor. This training program was divided into three working phases: two months of case studies analysis, a month of planning an innovative didactic course and, to finish, three months during which the phase two plan was developed.

**Scuola-Digitale/Lavagna**

This plan is an ANSAS project, a three years initiative aiming at introducing ICT into the classroom. All junior secondary schools can access to that programme through a call for applications.

The training model is very similar to DiGiscuola project, with a blended learning model.

**ICT Competences training and certification program – Portugal**

The Technological Plan for Education [TPE 2007-2010] (<http://www.pte.gov.pt/pte/EN>) was developed and presented by the Portuguese Government with the goal of mobilising efforts and implementing the structures that are needed for schools technological modernisation. TPE was structured into three interdependent axes: 'Technology', 'Contents' and 'Training'.

The main objectives of this programme were:

- i. To ensure the supply of computers and secure high-speed broadband connectivity for every school, teacher and student.
- ii. To support the development of educational digital contents, the generalisation of e-portfolio in schools, as well as sustaining collaborative networks and e-learning initiatives.
- iii. To promote teachers' professional development in ICT skills, through specific training and certification programmes.

The ICT competencies training and certification programme was a modular, sequential and disciplinary structure, organised in three levels:

Level 1: Digital competences certification;

Level 2: ICT pedagogical and professional certification;

Level 3: Advanced educational- ICT competences certification.

To obtain those certifications, teachers had to attend ICT training seminars/workshops in several areas (for example, Whiteboards in education, Special Education Needs and ICT or Professional and pedagogical ICT competencies).

A national council is in charge of (i) certifying the teachers training entities and (ii) supervising the evaluation system of continuing training. After that, those entities train teacher trainers in specialised areas.



## D4.1\_Teacher skills and competence development

While teacher trainers attend blended-learning courses (15 hours + 10 hours distance), teachers have 15 hours of courses.

The model of training was designed in a longitudinal form: 30% of teachers attend the priority courses; in the second year those goals are extended to enrol those 30% of teachers who attended the priority courses while allowing another 30% to join two courses; the third and fourth years are based on the same process. In the end 90% of the teachers get a certification (GEPE, DGRHE & DGIDC, 2010).

1st year - 2010	2nd year - 2011	3rd year - 2012	4th year - 2013
30% of teachers A: 1 course	Teachers A: 1 course	Teachers A: 1 course	Teachers A: 1 course
	30% + Teachers B: 2 courses	Teachers B: 1 course	Teachers B: 1 course
		30% + teachers C: 2 courses	Teachers C: 2 courses

## 4. ICT TEACHERS' IN-SERVICE PROFESSIONAL DEVELOPMENT

For teachers' professional development this document considers all the “activities that develop individual skills, knowledge, expertise and other characteristics as a teacher. This definition recognises that development can be provided in many ways, ranging from the formal to the informal. It can be made available through external expertise in the form of courses, workshops or formal qualification programmes, through collaboration between schools or teachers across schools or within the schools in which teachers work” (TALIS, 2009, p. 49). This part of the document aims to focus on teachers' education and continuous or in-service professional development, considering iTEC intentions of:

- . *Developing new models to support teachers' digital and pedagogical competences based on a blended approach that combines face-to-face workshops with online continued professional development and support* (ITEC Project, Annex I- Description of Work, Task 4.1, p. 21),
- . *Setting up and animating an online community of practice for teachers, providing an online environment to run both formal and informal continuous professional development (CPD) using tools and services that feature in the future classroom, which will be used to support the selection and training of teachers for each cycle of scenarios* (ITEC Project, Annex I- Description of Work, Task 4.5, p. 23),
- . *Selecting and publishing online resources for enabling teacher education and to use them as support for the implementation of the scenarios selected* (ITEC Project, Annex I- Description of Work, Task 4.4, p. 23).

Therefore this chapter will be organised around two elements:

- 1) A literature review covering the facilitators and inhibitors of ICT integration into teachers' professional practices. Reasons justifying the reduced effectiveness of previous years' programmes promoting teachers ICT-competences will also be presented as they can inspire the design of an effective model of professional development;
- 2) A list of principles that are seen as unconformable in teachers' professional development initiatives but should be integrated into all iTEC activities related to the support and promotion of teachers' digital and pedagogical competences.

## **4.1 Facilitators and inhibitors of ICT integration into teachers' professional practices: lessons-learned**

The introduction of ICT in today's educational contexts represents the largest and most complex curricular innovation that has ever been perceived, to the extent that (i) it covers the whole curriculum and all the subjects, (ii) it reaches all levels and cycles of education, (iii) it is expected to be taken by all teachers, (iv) it integrates diverse educational softwares and technological tools;(v) it requires new creative and engaging teaching strategies and learning methodologies; (vi) it reveals impact on the quality of teaching practices and (vii) it has to produce remarkable effects on students' learning.

However, the internet, ICT in general and new web tools are seen as social artefacts that have a great pedagogical potential. In fact, technology often tends to be marked as (i) a privileged means to access information, (ii) a key tool to think, create, communicate and intervene in many situations, (iii) a useful tool for collaborative

work, (iv) representing a support of human development in the personal, social, cultural, recreational, civic and professional domains.

Access to information at any time and at different paces can promote more flexible and tailored learning to students and increase the quality of teaching-learning processes as well as the capacity to articulate the use of resources outside the classroom.

While being recognised as relevant and favouring efficiency and innovation in the teaching process, the truth is that international projects and national programs from the past two decades promoting the integration of ITC into the classroom are too often referred to as having achieved limited impact on students' performance. Several studies show that the economic investment made over the past few years to equip schools with new technologies, was not translated into proportional gains and improvements at the educational level; the abundance of equipment by itself has not guaranteed or even represented a generalization of its use (Bebell, Russell & O'Dwyer, 2004; Brunner, 2004; Christensen, Knezek & Griffin, 2001; Christensen, 2002; Cuban, 2001; Kadel, 2005; Karagiorgi & Charalambous, 2008, Liu & Huang, 2005; McKenzie, 2002; Norton, McRobbie & Cooper, 2000; Pierson 2001, Pratt, 2002; Younie, 2006; Wang, 2002).

Yet some progress has been achieved, the use of ICT is growing since the early 90s, (European Commission, 2010). And since then some authors have collected data that today enable us to have a clearer notion of the factors that could facilitate the integration of technology into teaching practices. In 1995 Means, Ruskus and Olson, (1995) pointed out the importance of i) adequate access to technology, ii) time for teachers to learn how to use available technologies and incorporate them into their own teaching objectives, iii) the allocation of time and effort to build and develop a shared and consensual vision at the school level about what is expected with the integration of technology, iv) fast and easy access to technical support, v) the recognition of the advantages associated to the work with technology; vi) good teaching resources and curricula; and vii) the possibility of developing projects that provide opportunities for teachers to work collaboratively.

Focusing specifically on the barriers of ICT integration in the European educational context, Brimkerhoff (2006) identified four different types of constraints that had great effects on the use of technologies by teachers. On one level, the inaccessibility to technology and the weak quality of softwares are underlined. On a second level, institutional or administrative constraints are identified, such as limited funding, lack of technical and institutional support, lack of incentives and overcrowded schedule. On a third level, there are difficulties related to teaching skills, low levels of technical skills and low investment in staff training. On a fourth level, factors such as negative attitudes towards the use of technology in teaching, adding further resistance to change, lack of confidence, professional disinvestment and low sense of self-efficacy are considered.

On the other hand Daly, Pachl and Pelletier (2009) judge as highly important the 'psychological stress' that educational policies create through the strict definition of metrics only set out to be achieved. This leads to the established practices of 'drill and practice' remaining only on a superficial level of understanding and diverting attention from the quality, consistency and richness of pedagogical use of ICT.

Other researchers (e.g. Liu, Maddux, & Johnson, 2004) point to another dimension related to school practices: the time factor (BECTA 2004; Bingimlas, 2009; Buckenmeyer, 2008; Vannata & Fordham, 2004). The amount of time invested in learning and using technology has a positive correlation to achievement. When time is perceived as inadequate or limited, teachers often resort to what they already know. "Their interest and enthusiasm in exploring new pedagogical approaches using technology will, therefore, wane. "Time is an essential ingredient" (Liu, Maddux, & Johnson, 2004, p. 601).

Assuming a distant location of the various structural constraints set out above, Schoepp (2005) found that, even when all the restrictive effects of environmental factors are eliminated (such as lack of access to technologies of quality, time scarcity, restrictions on institutional support and technical support) it is still not guaranteed that teachers will adopt the technologies made available. The author advocates that some barriers still remain (especially those associated to

technological skills and competences) and that they effectively determine the level of technological integration. Several researchers confirmed that, in order to implement a real integration of technology, the development of digital proficiency and technological expertise by educators should be one of the key aspects to ensure (Goole, Kautz & Knuth, 2000; Ivers, 2002, Liu & Huang, 2005; Scrum, 1999). In fact, the lack of specific preparation for the use of technology tends to be repeatedly checked in literature, and over several decades, as one of the most serious obstacles to full integration of technologies in schools (Culp, Honey & Mandinach, 2003; Hasselbring, Barron & Risko, 2000; Means, Ruskus & Olson, 1995; Norris, Soloway & Sullivan, 2002). Lawless and Pellegrino (2007) state that no teachers have the required training and as they don't feel comfortable in using such equipment, they will hardly envisage ICT as a resource or possible strategy to use in the classroom.

Yet, the figures and organisations responsible for defining teacher training seem not to have understood that message. According to Goole, Kautz and Knuth (2000) approximately 30% of the budget for promoting the use of technology in schools should be invested in teachers' professional development; however, the authors show that in several countries surveyed (mainly in the North and South America), there is no more than an average of 9%.

Not denying the importance of teachers' training, several studies (Condie & Munro, 2007; Galanouli, Murphy & Gardner, 2004; Harrison, Comber, Fisher, Haw, Lewin, McFarlane, Mavers, Scrimshaw, Somekh & Watling, 2003; Ivers, 2002; McKenzie, 2002, Simpson & Payne, 2002) indicate that, despite the fact that the training contributes to increase knowledge and teachers' skills in ICT, there is no clear evidence of effective changes in teaching practices in the classroom.

Many criticisms begin to emerge in the literature related to the way such ICT-training programs have been designed and implemented. In such documents teachers' training in ICT are generically referred to as:

- streamlined and implemented by professionals without real knowledge about the needs, interests and current characteristics of teachers and students (Education Week, 2002); disconnected from the curriculum content (Cohen &

Ball, 1999) and the actual activities that take place in today's classrooms (Goole, Kautz & Knuth, 2000);

- insensitive to different levels of knowledge of teachers (Christensen, Knezek & Griffin, 2001, Liu & Huang, 2005), or in other words, asymmetric and depersonalized (Schoepp, 2005);
- excessively focused on technical mastery of tools, applications and software (Daly, Pahl & Pelletier, 2009; White & Myers, 2001);
- too limited in duration (Mills & Tinch, 2003) and therefore, too intensive,
- not yet matched by any follow-up mechanisms (Bliss & Bliss, 2003), that are seen as highly relevant (Martin, Strother, Beglau, Bates, Culp & Reitzes, 2010).

Similarly, Daly, Pahl and Pelletier (2009) state that teachers frequently show dissatisfaction with the ICT training models that have been adopted in their countries. According to the teachers surveyed, these models normally rely on external training programs that do not take into account the specific contexts of schools, present to be poorly planned and lacking quality in design.

A new relationship needs to be established between teachers, technologies and training. In this area, Munoz (2009) presents directed towards the emergence of new teacher identities, suggesting the need for a redesign of the concept of 'teacher', which implies, in turn, to rethink the institutions of education as elements in line with the profound changes taking place in various areas of today's social life. The second consideration relates to the need of reviewing the framework of teachers' professional skills. The third is associated to the need to implement new learning environments and methodologies for teachers' professional development, both pre-service and in-service training (face-to-face and online). Inspired by these innovative teaching and learning approaches teachers would likely implement them in their teaching practice.

Additionally, it would prove necessary to establish strategies so that teachers keep actively involved in **self-training initiatives**, trying to keep up (to some extent) with developments in technology, pedagogy and didactics. In fact, research (Vannatta & Fordham, 2004) shows that the degree of ICT integration presents variations according to teacher's beliefs and perceptions regarding its benefits and the resulting innovations. Teachers who spend more time exploring the technology and who are interested in understanding how to use them are the one who have higher rate of ICT-use. Thus it seems that the adoption and adaptation to technology is presented as a process that requires involvement, dedication and interest in innovation, which in turn dictates the need for capturing and retaining teachers with high level of motivation, teachers who invest deeply in the ownership of technical and instructional skills, enabling them to better planning, implementing and reviewing their teaching methods (Goole, Kautz & Knuth, 2000), teachers who have open attitudes to exploration and learning (Kadel, 2005). According to Dzubay (2001), it is the motivation that promotes, nurtures and maintains involvement in educational innovations, which ICT-use in classrooms tends to be. Thus personal factors (in the domain of beliefs, attitudes and / or motivation) appear to be the factors that, in fact, influence the adoption / integration of technology in classroom practices directly and also indirectly, because they also determine how teachers perceive all other factors. Many studies confirm that teachers' negative attitudes are the main obstacle to innovation and professional development in the area of technology (Atkins & Vasu, 2000; Becker, 2000; Ertmer, 2005, Liu 2005, Liu & Huang, 2005; Norton, McRobbie and Cooper (2000) Woodbrigde, 2004).

In conclusion, the process of integration of technology in education, as in general for all innovation processes, tends to be multifactorial. The factors that are behind it are multiple, complex and interrelated in a web which is hard to tackle.

To all the previously listed factors, we could add some observed lack of political will to enable changes in the school system with implications in the way innovation is addressed in schools, an asymmetry between the possibilities brought in by technology and the landscapes allowed by curriculum constraints that maintain traditional subject organization aside trans-disciplinary models of addressing science



and certainly the constraints (naturally) imposed by the school structure such as inflexible timetables and rigid collective rhythms.

Although not explicitly referred in the literature it is important to question the preparation and lack of experience of teacher educators in the institutions running pre-service and in-service programmes for teachers, more specifically in the way they use technology in teaching and learning activities.

## **4.2. Principles for teachers' professional development initiatives**

A list of principles is presented; these principles draw on relevant models for teacher education that could be integrated into iTEC practices.

The following principles emerge from a desk-research developed in order to identify relevant 'ICT- competences for teachers' standards and frameworks. The following frameworks were taken into consideration (5 from a total of 9 analysed frameworks):

- The pedagogical method proposed by the EPICT Project (European Pedagogical ICT license)
- Portuguese Referential for ITC-Competences for Teachers (Costa, 2008)
- CERI - ICT and Initial Teacher Training (OCDE, 2008).
- Policy Framework of ICT Competency Standards for Teachers (UNESCO, 2008)
- ISTE\_NETS Standards for teachers

- European School Projects, such as CELEBRATE, METASchool and Digital Skills Working Group (DSWG) were also considered.

Although skills' training is clearly vital for teachers to be able to integrate technology into professional practice, research shows that basic technical induction is rarely enough to allow the maximisation of the potential of technology and to develop ICT-enriched teaching practices (Daly, Pachler &, Pelletier, 2009). The evaluation of the effects of ICT teachers' training programs evidenced a persistent lack of ICT integration into teachers' practice and a reduced impact on the quality of classrooms learning activities. In-service professional development (ISPD) initiatives have not led to the degree of change that was anticipated. Many studies have justified this lack of expected changes with the fact that training initiatives are generally more focused on technical dimensions and should instead take into account the pedagogical dimension (Daly, Pachler & Pelletier, 2009). Studies such as STEPS (Balanskat, 2010), which has integrated literature review inputs from different European countries, show that one of the main barriers is teachers' lack of pedagogical skills and vision to integrate ICT in teaching and supporting the learning processes. Access to technological equipment and broadband infrastructures were developed as well as programmes for teachers training in ICT skills, where technical mastery of tools and systems was promoted.

This unbalanced approach that puts technology and pedagogy into a non-justified opposition was created by misunderstandings and critical errors in the historical process of ICT integration in education. In the iTEC Project ICT teachers' professional initiatives should be developed under a synchronized and well-balanced perspective in which the technical aspects, pedagogical concerns, methodological strategies and curricula-integration are thought together (UNESCO, 2008).

Although teachers competences are critical for ICT integration into the school context, the ICT\_TCPD model that will be selected for framing iTEC activities should also pay attention to attitudes and representations (OECD, 2009), as teachers' sense of efficacy, motivation and pedagogical assumptions are frequently presented

as the heaviest barriers to eliminate (Kadel, 2005; Lumpe & Chambers, 2001; Vannatta & Fordham, 2004).

National plans for integrating technology into educational settings show a prominent dissatisfaction of teachers with the 'one-size-fits-all' model of training, which does not take into account the specific contexts of the schools. Empirica (2006) refers to countries such as Germany, France and Spain. Other reports highlight the same trend in Portugal (Costa, 2008) and United Kingdom (Department for Culture, Media and Sport & Department for Business, Innovation and Skills, 2009). There are also serious disappointments with school-based initiatives for ICT professional development, which tend to be characterised as poorly planned and not-curriculum oriented. School-programmes do not take into account (i) the subject differences and (ii) the varied levels of teachers' technical skills and experience. Therefore, self-paced learning paths for each teacher addressing teachers' individual needs reveal an optimal level of flexibility for admitting different levels of ICT-use expertise.

The design of teacher education scenarios, resources, tools, etc. also needs to be as classroom-focused and close to daily practice as possible, e.g. hands-on training session resources and follow-up materials, showcase good examples of practice, adjustable lesson plans (EPTIC, 2008). The approach assumed for ICT teachers' continuing professional development should be as close as possible to in-service training initiatives.

ICT is seen as an inter-disciplinary domain; therefore some examples should be developed in relation to primary schools subjects, ICT, Sciences and Mathematics as requested in ITEC Project. Yet transversal examples should be described too.

As Celebrate Report evidenced, teachers repeatedly report a lack of knowledge regarding the integration of ICT into their normal curriculum activity, partly because there seems to be a lack of sophisticated curriculum-related learning materials (Jaakkola, 2003). It will be very important to develop and publish easy-to-use manuals regarding iTEC tools and environments, learning scenarios and materials (both for students and teachers training), shells, etc.

The development of accessible and high-quality educational products/resources is also seen as important to consider (iTEC Task 4.4. will take this into account).

The analysis of national plans evidenced that these programs tend to be developed for reduced periods of time (2/3 years) which may not produce deep changes into teaching practices (Fonstad & Lanvin, 2010) as the pressure to achieve short-term solutions leads to surface level adoption. One of the tasks elected by iTEC is to develop online communities of practice for teachers, where teachers will be able to create partnerships and collaborate within a community, to share ideas, successes and difficulties with peers and where they will have access to national coordinators, high-tech and pedagogical expertise. This can contribute to a more solid and sustainable teachers' professional development, mainly by peer-support and informal learning experiences (NETS, 2008).

Many of the features of successful ICT\_TCPD indicate that participation in a community of practice may be established as part of an international/national programmes or within the school. Informal online discussions and social relationships are vital to the ways in which teachers exchange information and ideas about teaching with technologies. Not only for students but also for teachers, the peer-to-peer horizontal level of social interactions presents to be highly efficient for individual learning and development.

ICT\_TPD activities could benefit from concentrating on the orientation of teachers education (face-to-face and online workshop) for the design and planning of learning objects clearly related to authentic activities and real-world based projects for students (Celebrate Project, Metaschool LLP Project, 2010; U.S. Department of Education Office of Educational Technology, 2010). This suggests a clear understanding of related subject/topics and the several students' competences to be promoted.

The incorporation of a variety of digital tools as well as new teaching strategies, considering different methodologies (UNESCO, 2008), like enhancing independent thinking, group work, collaborative problem-solving, project based learning) with a clear view on how and when technologies will support these processes, are essential

exercises for teachers. Similarly, the design of continuous professional development workshops and materials, in itself, should incorporate these different kinds of activities using ICT, so that teachers can experience active and collaborative learning for themselves as part of their professional development. This can also contribute to a significant amount of learning scenarios developed by the teachers.

## **5. CONCLUSIONS**

This final chapter aims to synthetize some of the previous ideas and, from an operative perspective, use them to define guidelines for the development of iTEC initiatives regarding teachers' continuous professional training, specifically "the production of modules for teacher education which include a framework of competences, orientation for the development of tasks and selection and production of resources" as referred in iTEC Description of Work- Deliverable 4.1 (p. 25)

In order to ensure an optimal integration of ICT in schools teachers need to be provided with

- powerful and pedagogically innovative webtools,
- quality ICT resources,
- effective professional development,
- sufficient time to develop and mature technical and pedagogical competences
- in-time technical support.

One component won't be enough but the presence of all components increases the likelihood of excellent integration of ICT in learning and teaching opportunities.

iTEC should consider the development of innovative solutions (components of iTEC environments+ Composer and manual + Shells) that present to be aligned with today's and tomorrow's teachers' training needs. Even more, technical developers should aim to develop applications that are easy to use and exploit and that could trigger the development of teachers' digital competences.

Aligned with the tools/services developed in iTEC shells, easy-to-use, inspiring and good quality resources to support teachers' use of those tools must be developed and make available for teachers in the online community of practices for support teachers education (in-service training materials focused on advanced pedagogies, training materials for using iTEC environment +shells, involve support on implementation of specific scenarios).

Teachers' education initiatives should be mainly focused on informal learning, operationalized in training modules that are developed and made available for teachers in the online community of practice. These training modules should be developed considering the 3 different levels of competences enunciated - functional level, enhancement level and innovative level. Training modules should be differentiated so as to build individual levels of competence from these starting levels. They should be based on self-paced and individual training activities but synchronous activities (webinars with experts, chat sessions between teachers from different countries but who teach the same subjects and who are piloting the same scenarios, etc.) could also be scheduled.

The training modules must also be aligned with the 5 domains of competences identified in teachers' digital literacy. For each domain some examples of modules that could be created are identified:

- Digital knowledge domain (e.g. 'New teaching strategies: community-based learning', '21<sup>st</sup>-century skills for students');
- Planning & management domain (e.g. 'New assessment methods: e-portfolios for students');
- Classroom practices domain (e.g. 'Online communication and collaborative tools: using it to communicate with parents and other educational agents'),
- Professional growth domain (e.g. 'Exploring team-teaching: challenges and benefits');
- Social & ethical domain (e.g. 'Multicultural literacy: what is it and how to promote it?'; 'Online multiple identities', 'Web security: internet control software vs. teaching for online protected conducts').

This deliverable also presented relevant literature regarding ICT integration & teachers training which provided valuable lessons learnt and pitfalls to avoid in teachers' education. It is important that when designing activities for teachers WP4 take them into account, whether it concerns the development of technical and pedagogical competences, ways to avoid mistakes frequently made (decontextualised training disconnected from teachers' classrooms, trainers lacking pedagogical credibility, lack of social interaction) or to address barriers mentioned by

teachers (such as lack of access to technologies of quality, time scarcity, restrictions on institutional and technical support).

It is also important that National Coordinators, both technical and pedagogical, ensure that the training provided for teachers throughout all iTEC cycles:

- provides a balance between technical aspects, pedagogical concerns, methodological strategies and curricula-integration,
- takes into account teachers' differing motivations, learning styles, levels of confidence and ICT skills,
- is close to teachers' (national) daily practice,
- includes examples of practice that have been accomplished in similar circumstances by similar teachers,
- uses curriculum-related materials,
- makes use of high-quality tools, content and applications,
- leads to self-sustaining online collaborative communities of practice that endure,
- should involve teachers as researchers and active participants in their development.

WP4 National Pedagogical Coordinators must also be familiar with the three levels of ICT competence identified in section 1 - Functional, Enhanced and Innovative - as well as the 5 domains defined, and should ensure that teachers can assess their competence against them.

National pedagogical coordinators should also build upon existing national models of training and schemes, and also consider linking to eTwinning and aligning with the content covered in the European Pedagogical ICT Licence.

It is also seen as important that national pedagogical coordinators design the country-specific implementation of pilots such that they contain sufficient challenges to help teachers involved in them develop professionally, but that they are also achievable. National pedagogical coordinators could consider the use of a diary or self-reporting form for teachers to record their progress and challenges overcome.



Finally, the learning scenarios developed for piloting in each cycle should also integrate a section with the teacher competences required, following the process outlined in figure 4 of this document. The training and support that will be made for each learning scenario should take into account the different competences needed.

Work package 4 partners should also seek to incorporate the evidence-based features of good practice described in the section 2 (Pedagogical models for the 21-century classroom) in designing and implementing classroom activities.

It is very important not to forget that WP4 partners should seek to embed iTEC professional development within their national contexts and assessment regimes, taking into account the wide variations identified in this section between countries. Teachers in different countries will have very different experiences of topics and methods of continuous professional development.

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## **ANNEX**

## **Annex #1: Analysis of frameworks of 21st century skills**

Through content analysis methods 13 framework proposals (17 documents) were compared. A cross-match of different domains of skills presented by each framework was developed. The frameworks were selected through literature review, a process that was based on searching data on (i) web-engines (Google) and (ii) digital library of education literature (ERIC) for frameworks related to:

- 21st-century skills/ competences,
- digital literacy/media literacy,
- skills/competences for tomorrow,
- new millennium skills/competences,
- digital natives skills/competences,
- net-generation skills/competences.

The selected resources are only documents that specifically present a proposal for conceptual and operational framework, documents that show as first and recurrent results on both web-engine and ERIC, and documents that were published after 2005. A first list of 51 resources available was therefore reduced to 17 and the following documents were analysed:

### **Framework 1. Digital Transformation: a framework for ICT literacy: A Report of the International ICT Literacy Panel**

In January 2001, Educational Testing Service (ETS) convened an international panel to study the growing importance of existing and emerging Information and Communication Technologies (ICT) and their relationship to literacy. The panel deliberations had two major themes. First, ETS, along with the panel members, wanted to examine the need for a measure of ICT literacy across countries as well as within specific organizations, such as schools and businesses. Secondly, ETS and

the panel wanted to develop a workable Framework for ICT Literacy, that would provide a foundation for the design of instruments including large-scale assessments intended to inform public policy and diagnostic measures to test an individual's skills associated with information and communication technology.

## **Framework 2. Digital Competence for Lifelong Learning Policy Brief**

This policy brief has been prepared by the Institute for Prospective Technological Studies and the goal of this policy brief is to summarize key messages from recent IPTS research related to the needs for digital competence for the purposes of work, leisure and learning in the European Information Society.

## **Framework 3. Standards for the 21st century learner**

In this publication the American Association of School Librarians provides some standards to describe the 21st century learner. The document focus four key topics: (i) skills such as understanding and thinking; (ii) dispositions in action - on-going beliefs and attitudes that guide thinking and intellectual behaviour; (iii) responsibilities - common behaviours used by independent learners in researching, investigating, and problem solving; (iv) and self-assessment strategies - Reflections on one's own learning to determine the skills, dispositions, and responsibilities that are effective.

## **Framework 4. . America Association of school Librarians & Association for Educational Communication and Technology; Information Literacy Standards for student learning**

Information Literacy Standards for Student Learning provides a conceptual framework and broad guidelines for describing the information-literate student. The standards consist of three categories, nine standards, and twenty-nine indicators. Taken together, the categories, standards, and indicators describe the content and

processes related to information that students must master to be considered information literate.

**Framework 5. P21 Framework Definitions Document - Partnership for 21st- century skills. Partnership for 21-st century skills, (2009). P21 Framework Definitions Document (F5)**

This definitions document provides guidance to educators who are working to make sure the K-12 education system provides all students with rich core content and 21st century skills. The framework defined in this document presents a holistic view of 21st century teaching and learning. It presents a vision for 21st century student outcomes (a blending of content knowledge, specific skills, expertise and literacies) and the support systems that are needed to produce these outcomes.

**a. Partnership for 21st century skills (2007). 21st Century Skills Assessment.**

This Article provides guidance about student's assessments because assessment is a cornerstone of effective teaching and learning. In this document is discuss what are the characteristics of assessment in 21st century and how states can create an implement assessment to promote 21st century skills in their classrooms.

**b. Partnership for 21 st century skills. Learning for the 21st Century: A report and Mile Guide for 21st century skills.**

The partnership for 21st century skills provides, in their first report, a unified, collective vision for education and framework for action. They also provide a companion guide for getting started, their Milestones for improving learning and education (MILE) Guide for 21st century skills. They developed both the report and the MILE guide through a comprehensive process involving hundreds of educators, researchers and employers across the country.

**c. Partnership for 21 st century skills. The Intellectual and Policy Foundations of the 21st Century Skills Framework.**

In 2007 the Partnership for 21st Century Skills released an updated version of its 21st Century framework which encapsulates the outcomes and support systems needed to prepare students for 21st century life. While the framework's primary focus is forward-looking in identifying the learning needs of the future, it may be less apparent that the framework is bolstered by time-honoured learning practice and theory, as well as more recent research on the modern workplace. By tracing the interplay between societal demand and educational response, as well as the implications of advances in learning science and learning technology, this white paper aims to make visible the theory, research and policy antecedents that support the 21st Century Skills Framework.

### **Framework 6. PLA-Vienna Final recommendations on digital competence report ICT -2008**

The ICT cluster set up under the Education and Training 2010 Work Programme and representing the Ministries of Education of several Member States met in October and again in December 2008 to discuss the key role of digital literacy / competence for lifelong learning.

### **Framework 7. National Educational Technology Standards (NETS-S) and Performance Indicators for Students**

The International Society for Technology in Education publish a document when summarize standards and performance indicators for students in 21st century. It provides also a model for teachers to implement and assess learning experience that engage students and improve learning.

### **Framework 8. WP6 Digital Literacy and ICT Skills**

The project "Benchmarking in a Policy Perspective" was started by the European Commission in January 2006. The objective of the "Benchmarking in a Policy Perspective" project initiated by the European Commission is to carry out an in-depth

analysis of the results of the annual Information Society Surveys of households and enterprises and to relate them to a number of specific themes. In this project it is referred the availability of adequate skills for developing, implementing and using information and communication technology (ICT) as an important condition for the competitiveness and the innovation capabilities of the European economy. The skills which are required go far beyond the narrow confines of ICT practitioner skills within the ICT industry, but also comprise ICT practitioner skills in user industries.

### **Framework 9. Assessment Program Information and Communication Technology Literacy 2008 Years 6 and 10**

The first national sample assessment of Information and Communication Technology (ICT) literacy at Year 6 and Year 10 will occur in 2005, and thereafter every three years. This document provides information about the ICT literacy assessment including: Education Ministers' decisions regarding ICT; definition of ICT literacy; a description of the ICT literacy domain, strands and the progress map; types of items that will be used in ICT literacy assessment; and how the results from the assessments will be reported.

### **Framework 10. enGauge 21st Century Skills: Literacy in the Digital Age**

This publication is based on the work commissioned by the North Central Regional Educational Laboratory through the Metiri Group.

### **Framework 11. Department of Education 2008-2009 Colorado Model Content Standards Review**

The Colorado Model Content Standards exist for each Core Academic Discipline: Civics, Dance, Economics, Geography, History, Mathematics, Music, Physical Education, Reading & Writing, Science, Theatre, Visual Arts, and World Language. Recent legislation also calls for creating new standards in Financial Literacy to be imbedded in Math and Economics. As this process begins, the State Board and the

Colorado Department of Education are: Including a third party analysis of the current standards to inform how to refresh the standards as well as how to bridge pre-school and postsecondary expectations with the K-12th grade program and collaborating with the Early Childhood Education community, the Colorado Commission of Higher Education, and broad input from the community descriptions for its expectations of 21st century skills, school readiness, and postsecondary and workforce readiness.

## **Framework 12. Organization for Economic Cooperation and Development- 2005**

The OECD's Definition and Selection of Competencies (DeSeCo) Project provides a framework that can guide the longer-term extension of assessments into new competency domains. As OCDE Education Ministers said "Sustainable development and social cohesion depend critically on the competencies of all of our population – with competencies understood to cover knowledge, skills, attitudes and values."

This comparative analysis evidenced what core skills are more frequently pointed as relevant by education expertise and other stakeholder to achieve a full-sense of citizenship in the 21st-century. Therefore this core skills were consider to develop a set of recommendations for iTEC pedagogical models and teachers technical and pedagogical competences regarding the integration of ICT in education.

## **Framework 13. Research: What it says about 1 to 1 learning (F13)**

Apple, (2005). *Research: What is says about 1 to 1 learning*. Available at [http://ubiqcomputing.org/Apple\\_1-to-1\\_Research.pdf](http://ubiqcomputing.org/Apple_1-to-1_Research.pdf)

The present study, conducted under contract with Apple Computer, Inc., aimed to analyse research-based evidence from research studies published between 2001 and 2005 and to identify what is known and not yet known about: the effects of 1 to 1 computing initiatives on students and how students use laptops and wireless connectivity and what teaching looks like in 1 to 1 classrooms. The results of this research synthesis are intended to strengthen Apple Computer's support of 1 to 1 initiatives in four key ways: (i) clarify which claims about the effects of 1 to 1

initiatives are supported by rigorously-designed research studies; (ii) glean lessons from implementation studies about how 1 to 1 initiatives unfold under different kinds of circumstances; (iii) identifying potential targets for classroom-based assessment that teachers can use to document transformations in instruction and improvements in student learning; (iv) identify gaps in the knowledge base, which might be addressed in research and evaluation studies being conducted in conjunction with 1 to 1 initiatives that Apple supports.

In this publication the North Central Regional Educational Laboratory's "enGauge" describes a set of 21st century skills and they are very important because help students entering the work force. These skills are not at odds with traditional educational skills but in fact are extensions of those skills adapted to new technologies and new work environment.

An analysis of every skill cluster or competence category identified in the previously referred frameworks was conducted. A total of 26 different types of skills were identified. They were all related to transversal or interdisciplinary competences as following presented:

. **Metacognitive skills:** related to ability of actively thinking about personal thinking processes, involve 'using creative, critical, and metacognitive processes to make sense of information, experiences, and ideas for (...) developing understanding, making decisions, shaping actions, or constructing knowledge' (e.g. from framework 9).

. **Digital literacy Skills (technical domain):** involving the ability to 'use digital technologies (computers, PDAs, media players, GPS, etc.), communication/networking tools and social networks appropriately to access manage, integrate, evaluate and create information to successfully function in a knowledge economy' (e.g. from Framework 5); 'knowledge about what technology is, how it works, what purposes it can serve, and how it can be used efficiently and effectively to achieve specific goals' (e.g. from framework 10).



. **Creativity and innovative attitudes:** involve skills as ‘developing, Implementing and communicating new ideas to others, staying open and responsive to new and diverse perspectives’ (e.g. from framework 5), as well as developing new understandings, creating information and knowledge by synthesising, adapting, applying, designing, inventing or authoring (e.g. from framework 9).

. **Curiosity:** relates with intellectual curiosity, ‘creativity, innovation, integration of new ideas’ (e.g. from framework 11), which involves ‘ask significant questions that clarify various points of view and lead to better solutions’ (e.g. from framework 1).

. **Inventive thinking:** involve creating ‘new and worthwhile ideas, both incremental and radical concepts’ as presented in framework 5.

. **Effective communication skills:** articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts (e.g. from framework 5).

. **Information management fluency:** involve access, select, analyse and use information) or more explicitly ‘using digital technology, communications tools, and/or networks to access, manage, integrate, evaluate and create information in order to function in a knowledge society (e.g. from framework 1); it also integrates the ability to ‘reflecting on the processes of making judgements regarding the integrity, relevance and usefulness of information (e.g. from framework 9).

. **Autonomy, initiative and self-directional skills:** it is related to the individual ability to act as independent learner and pursue information related to personal interests; in the 21<sup>st</sup> century student must actively and independently seek information to enrich understanding of career, community, health, leisure, and other relevant topics (Framework 4); it involves effective self-management of learning in general: ability to dedicate time to learning, autonomy, discipline, perseverance and information management in the learning process.

- . **Inquiry and Critical Thinking:** encompasses the ability to put questions, to examine ideas, identify and critically analyse arguments (Framework 1).
- . **Problem Solving and Decision Making:** involves identifying/recognizing problems, interpreting information and drawing conclusions/solutions based on the 'best analysis, categorise, decode and clarify information' (Framework 1).
- . **Productivity and Accountability:** related to high productivity, to produce the most with the least resources which undertake the effective use of real-world tools for designing and creating relevant and high-quality products (identified in framework 10 and 12).
- . **Prioritize, plan, and manage actions:** takes in skills as effective scheduling and organization of activities, it involves the ability of plan, monitor, define, prioritize and complete tasks without direct oversight (e.g. from framework 1).
- . **Adaptability, Managing Complexity and Risk-taking:** related to the ability of constantly adjust to changing circumstances or environment or to work effectively in a 'climate of ambiguity and changing priorities' (Framework 5).
- . **Leadership and Team Work:** related with the capacity to leverage strengths of others to accomplish a common goal' (e.g. from framework 5)
- . **Interconnectivity:** emerges from increasing demand for interoperability of systems, which tend to conduct to a connected ecosystem of beings, tools, practices, organization and economies; it involves the ability to analyse and be aware of 'how parts of a whole interact with each other to produce overall outcomes in complex systems' (e.g. from framework 5)
- . **Interpersonal skills (empathy, respect):** takes into consideration skills such as the 'ability to create confidence and empathy in other individuals' (e.g. from

framework 1), which includes, but is not limited to, 'team resourcing, synergy, social skills' (framework 11)

. **Collaboration and Sharing skills:** involves to interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media (e.g. from framework 7).

. **Social responsibility:** it is related to the awareness about individual responsibility for social equity and community well-being, for the local and global perspective, it presupposes students 'who contributes positively to the learning community and to society, participates effectively in groups to pursue and generate information and recognizes the importance of information to a democratic society' (Framework 4).

. **Legal and ethical use of ICT / Privacy and security on web:** includes understanding the capacity of ICT to impact on individuals and society, and the consequent responsibility to use and communicate information legally and ethically; 'knowledge and awareness of internet security issues' (e.g. from framework 2), and respect from ownership of user-created content as well as network-developed content.

. **Scientific literacy and Research competences:** involves understanding the 'scientific concepts and processes required for personal decision-making, participation in civic and cultural affairs, and economic productivity' (e.g. from framework 10).

. **Economy and Marketing Literacy:** contains the ability to identify economic problems, alternatives, costs, and benefits; 'weigh costs against benefits' (e.g. from framework 10).

. **E-business skills :** integrates the capabilities needed to exploit financial opportunities provided by ICT, to ensure more efficient and effective performance of different types of organisations, to explore possibilities for new ways of conducting

business and organisational processes, and to establish new businesses (e.g. from framework 6).

**Cross-cultural skills:** refers to skills as ‘the ability to understand and appreciate the similarities and differences in the customs, values, and beliefs of one’s own culture and the cultures of others’ in a world where the phenomenon of multiculturalism is growing (e.g. from framework 10).

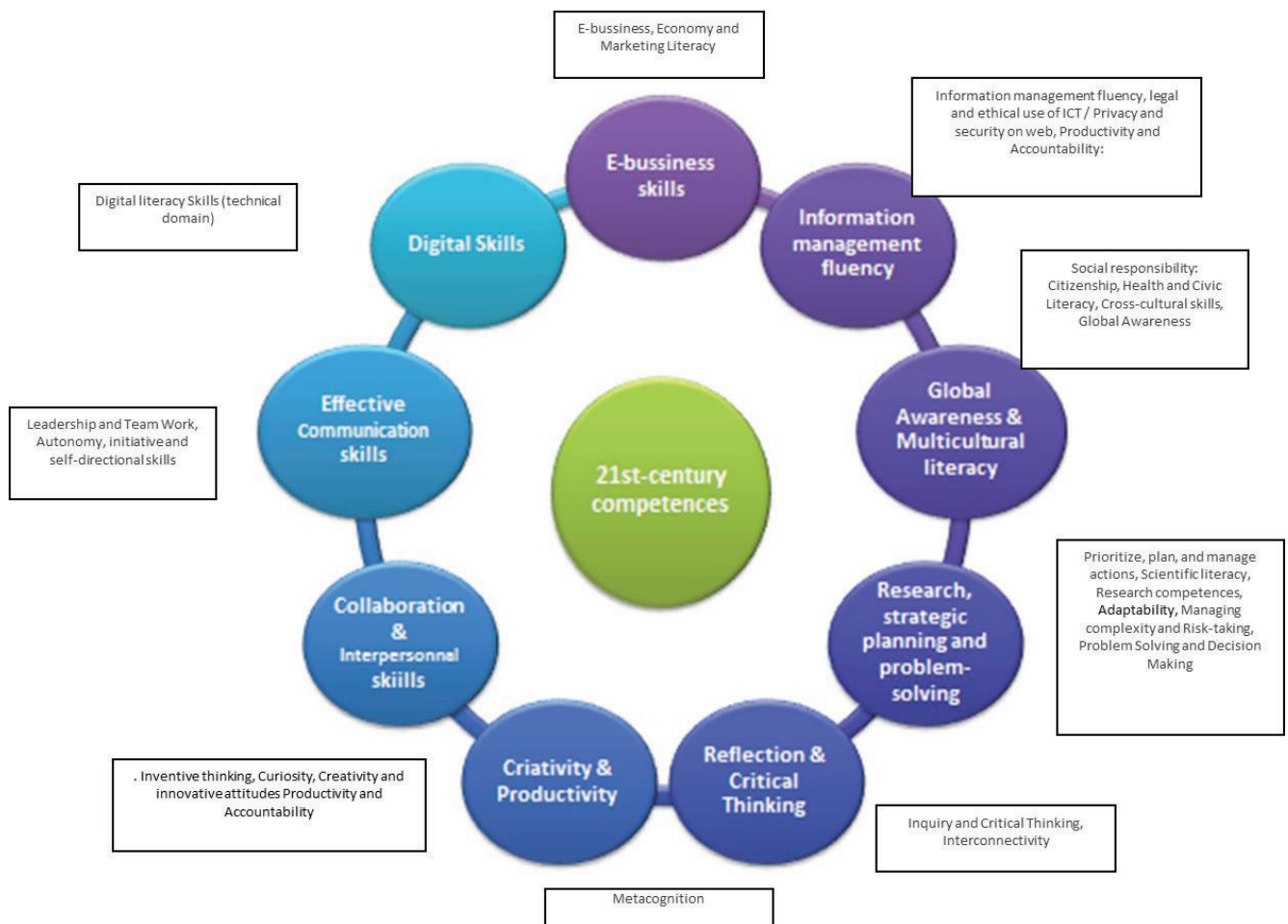
. **Global Awareness:** ‘Learning from and working collaboratively with individuals representing diverse cultures, religions and lifestyles in a spirit of mutual respect and open dialogue in personal, work and community contexts’ (e.g. from Framework 5) which presupposes recognizing and understanding of interrelationships among ‘international organizations, nation-states, public and private economic entities, socio-cultural groups, and individuals across the globe’ (Framework 10).

. **Health and Civic Literacy:** contains skills such as ‘obtaining, interpreting and understanding basic health information and services and using such information and services in ways that enhance health’ (e.g. from framework 5).

. **Citizenship:** competence related to knowing and ‘exercising the rights and obligations of citizenship at local, state, national and global levels’ (e.g. from framework 5).

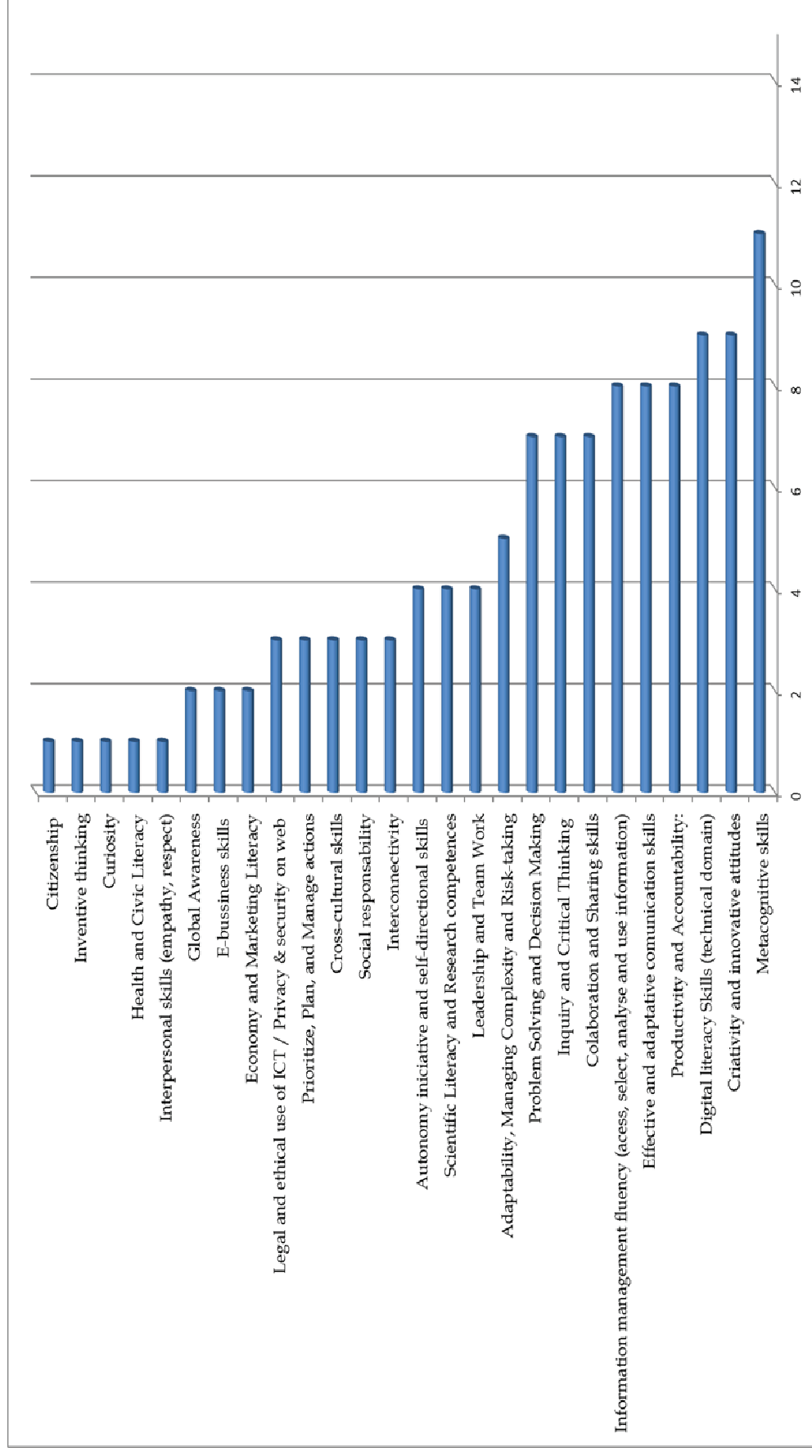
It is, therefore, possible to notice that 21<sup>st</sup> century skills involve not only practical abilities (at an operative level) but also knowledge mastery and ethical values, all considered in an intrapersonal and interpersonal perspective.

### Collaboration and Sharing skills, Interpersonal skills



With the purpose of analysing the commonalities between the frameworks, all the competences categories presented in each framework were identified and the total

amount of frameworks that pointed out each of them was organized and presented in the next graphic.



It possible to conclude that metacognitive skills are the most referred skills, being present at 11 of the 13 frameworks analysed. They were closely followed by 'Digital literacy skills (technical domain)' and 'Creativity and innovative attitudes', pointed out by 9 of the frameworks, and 'Productivity and Accountability', 'Effective and adaptive communications skills' and 'Information management fluency' all referred at 8 of the frameworks.

Those evidences show the prominence of skills related to higher-order thinking and profound analysis and reflection as well as skills related to the mastery of technology tools and the effective use of information in an increasingly knowledge-oriented and technologically-build society.

It was also possible to identify some differences between the frameworks, which are important to refer:

- six of the them only identified skills related to the ability of effectively using information and communication technology, giving evidence on how ICT has been dictating what is seen as crucial abilities for the present century;
- two of the frameworks are specifically focused on economic productivity and e-business skills;
- three of the 13 frameworks focused on the importance of intensifying the mastery of core subjects of the curriculum, referring Literacy skills (reading and speaking foreign languages), numeracy skills and economics skills. An exception was found on 'Scientific and research skills' which were particularly identified as a specific skills cluster at four of the frameworks.